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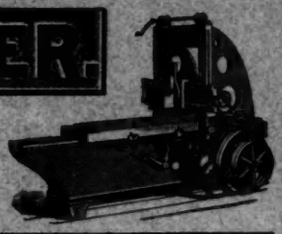

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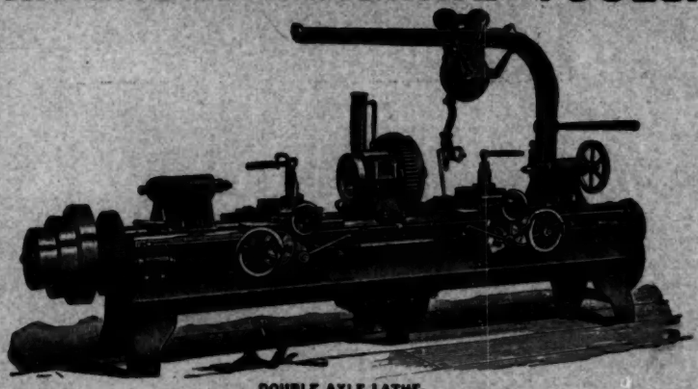

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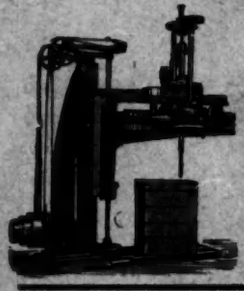

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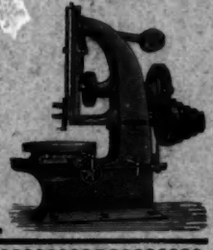

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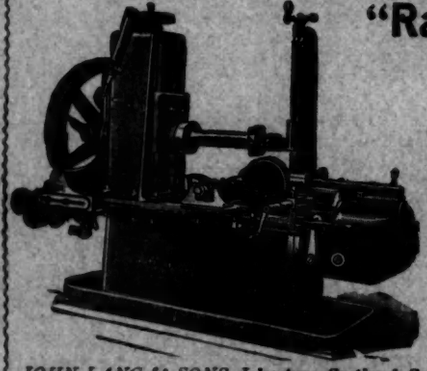

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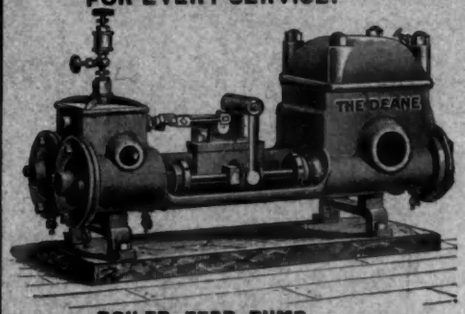

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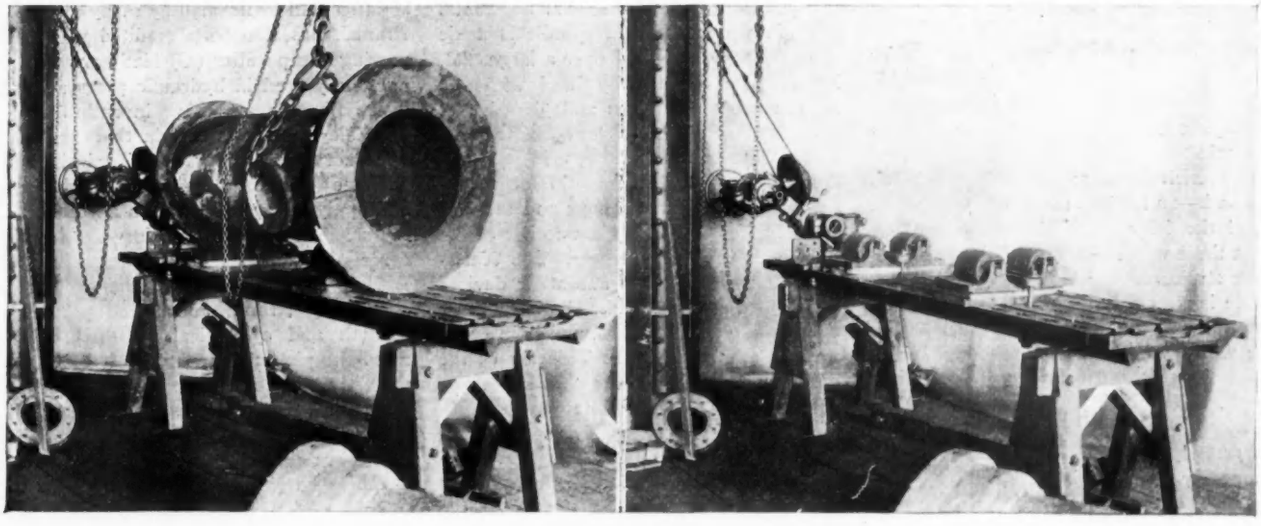
Pipe-Flange Drilling Rig.

BY JOHN RANDOL.

It is an awkward job to drill the flanges of heavy cast-iron pipe without something in the special tool way; so awkward, in fact, that it is quite common in well-equipped shops to see such flanges drilled with a portable driller, clamped to the pipe flange, and operated in a very uneconomical manner so far as time cost is concerned; and it is no very rare thing to find the humble and not hasty ratchet drill clicking its way through cast-iron pipe flanges in the shop or at the place where the work is erected. It is also quite common to find a heavy cast-iron pipe blocked up in the shears of a costly engine lathe, which might be much better employed than in drilling ¾-inch or ⅞-inch pipe-flange bolt holes. It is also common to see short lengths of pipe standing on end under the jib of a big radial driller, with the workman "blocked up" on a pair of wooden horses, with a box on top of them, to bring him high enough to use his chalk and prick punch and dividers and round-nose "drifting" chisel on the top flange of the awkward thing. Most common of all, perhaps, is an old, worn-out condemned engine lathe in some dark corner, or under an out-of-the-way shed, in unpleasant proximity to the castings cleaning department, with a pile of loose wooden blocks on the shears, waiting for the unlucky "cub," detailed to struggle with a lot of big pipe-flange holes, to come in with a couple of helpers and swear a flat, square-shank drill through the cast iron, in places not so very near where the holes should be. Plenty of us remember that old lathe with its broken face plate and square hole in the spindle, with a center punch mark about the size of a little-neck clam shell on one side of the spindle nose, to tell which way the square-shank flat drill must go in to run "true"—after it has been banged a few times with a hand hammer, of course—the old drill lathe that stood next to the rattlers under a 3-board shed roof, just wide enough to make the water drip down a fellow's back if it was raining, and not wide enough to keep the sun off if it was a hot day—we know how the oil froze up at the headstock oil hole the cold day, and how heavy the hammer felt on our cold left thumb when the center punch slipped out of our buckskin-mittened fingers.

Things are not done that way in pipe-flange drilling at the shops of the Excelsior Iron Works, 87-100 North Clinton street, Chicago, Ill. Far from it. When the planer table was worn out, the foreman knew it; not too soon, because no foreman—or proprietor either, for that matter—is ever quite quick enough to discover that the thing which was good once—very good, the pride of the shop and the envy of beholders—has, in the natural course of things, become an antiquated wreck, a money-eater instead of a money-maker, and that its real place is in the cupola, if strict justice were done all round, and that the best place for the unfit survival is in the show-room of a dealer in second-hand tools, "slightly worn, but equal to new for actual service." I see so many tools of this class in the shops through the country, every last one of the good old, honest, worthless things putting wasted time on the books of the eminently respectable, old, conservative, money-losing firms, who had the best plants in the vicinity thirty years ago, that I am really beginning to lose sleep over this absurd clinging to things be-



A PIPE FLANGE DRILLING MACHINE.

cause they were good once. I have a suspicion, which I will publish right here, that I am about to become a bore on this topic; all the same, my few declining years may as well be devoted to good deeds, and since I believe the very worst fault of American machine tool-users at this moment is their disposition to use old-style, inefficient, carefully-preserved tools, I shall continue my jobations on this subject until the fateful blue-pencil curtails my usefulness in that direction.

Nobody, as I was saying, ever replaces a planer-table too soon, and very few shops make a practice of reducing the thickness of a planer table so often as is needed. A planer table should be flat; there is no question as to the soundness of that proposition. The whole shop, from the chief draftsman to the boss blacksmith, thinks the planer table *is* flat, and depends on this supposed flatness; and if the planer tables in a shop are not pretty nearly flat, there are always a lot of resulting riddles and conundrums to be answered on the erecting floor, and the answers to these riddles commonly involve a lot of words spelled in print with stars and dashes and admiration points, as well as a good bit of filing and straightening-up holes, and hard feeling between the boss erector and the boss planer. We all know all about it—all of us old hands, anyway; the "cubs" will learn it, too, never fear. There will always be planer hands who will drop anything short of a 10-ton casting down on a planer table; they know it don't break a planer table to throw wrenches down on it, instead of laying them down, and they know a file will take off the raised border around the wrench dents, so the table will be all smooth—and what more do you want? And the foreman of the planers knows that these wrench dents and the hard surface strains to which the top of a planer table is always subjected, even with fairly careful usage, put rainbows into it; but he will always object to taking a scrape over the table. He knows it is a "little out"; and he will calmly assert that no planer table is ever exactly flat—they always "wind a little"—and so it goes until some fine day there is a grand clatter over a particular job, which comes off a little wrong everywhere, and then perhaps every planer table in the shop gets a scrape and everybody is happy for the next two years, in the assurance that all the planer tables are all right. In point of fact, a planer hand must be a mighty careful man; careful about handling wrenches and clamps and straps and blocks, and his work; and careful how he drives plugs in the table holes, to keep a planer table flat for three months at a time without taking a scrape over it. And if planer tables are kept flat, they wear down fast; and nobody ever stops to think that the work may be a good deal stiffer than the table is, and that, instead of bolting the work down to the table, the thin, weak, old table is bolted up to the work, and is rocking around on a good many different supporting points as it travels over the V's.

When the planer table shown in Figs. 1 and 2 was taken off the ways, it was put on a pair of good stout wooden horses, and two pairs of rollers in the simplest form of housings were made, suitable to clamp down on top of the table, where they would do the most good; and that settled the pipe-flange drilling question in the Excelsior Iron Works—and it was a pretty big question, too. The firm makes a great deal of pipe of that description; and when the roller blocks—which I do not think cost ten dollars, all told—were put on the old table, and a "Dallet" portable driller was bolted down at one end of the old planer table, it began to earn more money than it had ever earned before, and it has kept on earning money ever since. This is a rig which is not only suitable for drilling pipe flanges, but for a large class of work which is long and of such shape that it would have to go on an angle plate under the upright drill spindle. In fact, there is a great deal of drilling in every shop doing general work, which can be more easily and quickly and accurately done with a horizontal spindle driller than with an "upright"; and this condition is met, in some of the best-equipped general shops in the country, with a special horizontal drill, in which the drill spindle is made to cover a vertical field over a large, flat, horizontal table, usually level with the floor, made of cast iron and planed, and provided with T-slots for clamp bolts. The Watts-Campbell shops in Newark have a very fine driller of this class, designed by Mr. John Young; and the Ansonia Farrell Foundry has another of the same sort, very much larger. The Watts-Campbell machine has automatic devices for adjusting the spindle, both in horizontal and vertical planes, and is in every way an admirable tool. This rig of the old planer table and the "Dallet" portable gives exactly the same general combination, and is very largely used for general work, although the Excelsior shop is provided with an excellent assortment of drillers, upright and radial. It is the cheapest rig I ever saw, and one that can be profitably copied by every machine shop in the country doing a line of general work; for I am pretty sure that there is not one such shop which has not at least one planer table which deserves an honorable discharge from active service in its original commission.

In the Excelsior shops, cast-iron ring jigs are used to locate all flange holes; they are made in the same general form as that shown at the lower left-hand corner in Figs. 1 and 2. The drill holes are not bushed with hard bushings; they are plain holes in the cast-iron ring. These ring jigs are flat on both sides, and also have a position mark; they are clamped to the pipe flange, either side out, as is needful for meeting flanges, so that accurate spacing of the jig holes is not essential. Where, as in the case of the pipe (with snow sticking to the side) shown in Fig. 2, there is a branch which makes a definite position of the flange holes needful to make the branch point right, the position mark on the jig is used. The great advantages of such a set of cheap flange jigs are apparent at a glance. They bring all flanges of the same size to the Excelsior shop standard, in the easiest and cheapest possible way.

Notes on the Invention and Development of the Slide Rest.

BY W. F. DURFEE.

The article by Mr. F. Chadwick in "American Machinist" of December 19th seems to require some attention from me. The slide rest said to have been "patented" by Bramah in 1794, I have not been able to find a description of, and, as a matter of fact, Bramah did not patent anything in the year named, or if he did, there is no mention in the reports of any patent granted him in that year, or in fact any other, for the invention of a slide rest. I have no doubt that the construction of Maudsley's slide rest in Bramah's establishment has caused its invention to be attributed to Bramah by many writers. Bramah has also been credited with inventing the peculiar (U) leather packing frequently used in hydraulic presses; but Nasmyth claims this invention for Maudsley, and it is certain that Bramah does not illustrate or describe it in his patent of March 31, 1795, for "producing and applying more power to all machinery requiring motion and force." In his description of his invention he says: "*A* is a cylinder of iron or other material sufficiently strong, and bored perfectly smooth and cylindrical, into which is fitted the piston *B*, which must be made perfectly water-tight by leather or other materials (as is used in pump-making)." There is no description of how this is done; but a vertical section of the cylinder shows a piston having what seems to be a cupped leather attached to its lower surface, and on the inside of this there is a follower having a beveled edge, apparently to force out the edge of the leather cup. This follower is fastened to the piston by what appear to be tap bolts having slotted heads. There is no verbal description of this arrangement, and no claim made for it, and therefore it seems fair to presume that it was "used in pump-making" at that time. This conclusion is the more justifiable from the fact that seventy-two years earlier (1723), pump pistons constructed in a similar way were illustrated in Leupold's remarkable work.

Bramah was not the discoverer of the principle on which the action of the hy-

draulic press depends; this had long been known as the "hydraulic paradox," and over one hundred years before the alleged invention of Bramah the mechanical action involved had been described by Blaise Pascal in his treatise on "The Equilibrium of Fluids" (published in 1662), in which he speaks of two pistons, one being one hundred times the area of the other, and states that if a man presses the small piston with a force of 1 pound he will be able to raise 99 pounds on the large piston. Evidently the co-efficient of friction was 1 per cent. in Pascal's experiment. Belidor, in his "Architecture Hydraulique" (1737), describes the theory of the hydraulic press, and says "this machine is called the Water Lever." He also illustrates a plunger pump (used at York Buildings, London), in which the plunger works through a cup-leather packing (not the inverted U, but a cup of a right angle section). The plunger pump has repeatedly been attributed to Trevithick, but such a pump was described by Sir Samuel Moreland in 1683, fifty-two years before Trevithick was born. Nasmyth may have been entirely correct in assigning the invention of the U cup leather to Maudsley, but it is certain that neither Bramah nor Maudsley thought it of sufficient importance to be secured by patent; and it is equally certain that its importance as a mechanical expedient has always been enormously overrated, as it has always been possible to construct an efficient hydraulic press without employing it, and, as a matter of fact, great numbers of presses so made are in constant use, and in hydraulic jacks it is rarely, if ever, found.

Bramah's name appears in the British patent records as a patentee eighteen times in the period 1778 to 1814. Some of his inventions have not proved very useful, among which is a boat propelled by a stern wheel driven by a worm wheel.

Although Mr. Chadwick states in his first paragraph that the term "slide rest" has been used to describe "many forms of rest," he still thinks that the invention of Cherubini (1671) "can hardly be called a slide rest." If not, why not?—and what shall it be called? A "slide rest," in the general sense of the term, is a device for holding and guiding a lathe tool mechanically. This definition differentiates it from the much older fixed rest, on which the tool is held and guided by manual strength and dexterity. In a "slide rest" the cutting point moves in obedience to a law of the machine, but, by the use of the old stationary rest, the tool moves as directed by the will of its operator, as more or less imperfectly communicated and interpreted by his arms and hands. Mr. Chadwick's definition is special, inasmuch as it describes the perfected compound slide rest for moving the cutting point in some "straight line;" but there are well-known forms of slide rests which move the cutting point in a line convex or concave to the axis of the lathe. Such a rest was devised by John Anderson (the late Sir John Anderson, LL. D.) about 1830, who was awarded the annual prize of the London Mechanics' Institution for the "best machine or improvement of a machine." This slide rest employed precisely the principles of that of Cherubini, as illustrated by Figs. 13 and 14 in my article of October 31st, but in a much improved form, by which concave or convex surfaced solids of revolution could be turned with great precision.

Mr. Chadwick rightly thinks that the tool slide of the fusee engine can be "called a slide rest on a very small scale;" yet it does not satisfy the conditions of his definition, for it does not "guide the tool in a straight line." The movement of the tool in a fusee engine is on a curved line, and is so illustrated in Theout's work of 1741.

Mr. Chadwick seems to think that the illustration of Maudsley's slide rest (the "go-cart" of his fellow-workmen) as given by Olinthus Gregory, LL. D., cannot be an accurate representation of the invention of Maudsley, and evidently believes that the artist employed by Dr. Gregory did not do justice to the subject. I, of course, cannot speak positively in regard to this, but all the circumstantial evidence is against that theory. Dr. Gregory's work was published in 1815, but a few years after Maudsley made his "go-cart" slide rest at Bramah's. The description is prefaced as follows, viz.: "The improved lathes of Mr. Henry Maudsley of Margaret street, Cavendish square, are the most curious as well as the most useful we have seen. Mr. J. Farey, Jr., who took the drawings of these elegant specimens of mechanical ingenuity, has accompanied them with a description, etc." After describing the construction of a very ordinary lathe, that no one at this day would imitate, he goes on to say: "For turning the faces of wheels, hollow work, etc., where great accuracy is wanted, Mr. Maudsley has contrived a curious apparatus which he calls a slide tool." Mr. Farey, Jr., was quite correct; it was a "curious apparatus," and still deserves that reputation. As Mr. Farey, Jr., "took the drawings," it is but fair to suppose that he "took" them with the consent of Mr. Maudsley; and, so far as I know, the accuracy of the engravings has never before been questioned. Maudsley lived sixteen years after the publication of Dr. Gregory's book, and if there had been anything wrong in the engravings or their description, it is highly probable that some attention would have been called to it by him. Furthermore, this slide rest was illustrated in the American edition of Nicholson's "Operative Mechanic" in 1831 (this was a reprint of the third London edition), and again in Luke Hebert's "Encyclopedia of Machinery" (London) in 1836; and, yet again, in the fourth London edition of Nicholson's "Operative Mechanic" in 1853; and it does not seem probable that all these publications could have represented something that never had a tangible existence. Tomlinson (excellent English authority), speaking of the slide rest, says: "The invention of this instrument has been attributed to Henry Maudsley, but as early as 1772 an excellent slide rest was figured and described in the French 'Encyclopédie.'" This is the rest described in my article (Fig. 17) of October 31st. Mr. Chadwick states that "it was one of Maudsley's chief aims in perfecting the slide rest to obtain means of making accurate screws." If this was so, he would have done well to have studied the work of his countryman, Jesse Ramsden, who in 1776, long before Maudsley was old enough for a "powder monkey" (this was his first employment, according to Smiles), made a screw-cutting lathe having "change wheels," a lead screw, and a slide rest moved thereby—the arrangement being substantially that of the modern screw-cutting lathe—and he used this for cutting the driving screw of his dividing engine. This machine was purchased by the British Government and its description published to the world in 1777.

As regards Nasmyth's statement, I have recently furnished conclusive evidence (in issue of December 12th) that he was sometimes mistaken relative to his own improvements in the actuating mechanism of slide rests; and therefore it is very probable that he was in error in regard to Maudsley's.

Upon the whole I am inclined to say that I am "serious in asking" that the drawings published by Dr. Gregory be taken " as representing the slide rest designed and constructed by Maudsley."

Now a few words relative to the screw-cutting lathe of Jacques Bessoni, whose remarkable work, "Theatrum Instrumentorum et Machinarum," containing sixty copper plates in folio, was published in 1578, nine years after it was licensed by the king. The royal license and protection granted to Bessoni by Charles IX, of France, for the publication of this work, was really a royal patent for all the machines it described, and, therefore, Bessoni's book may properly be regarded as the "drawings and specifications" of this early patent; which, if not the first, is certainly more comprehensive in scope than any other granted to an inventor of machinery.

The announcement of the license of the king is such a curiosity that I quote it entire:

"THE LICENSE OF THE KING.

"By full and special license of the king given to Master Jacques Bessoni, author of this present work, for ten years in the near future, dating from the day when the work is finished by the printer; all persons of whatever rank or condition they may be, are prohibited to make,

counterfeit, engrave, sell or to consent thereto, even to the drawings for manufacturing the inventions contained in the

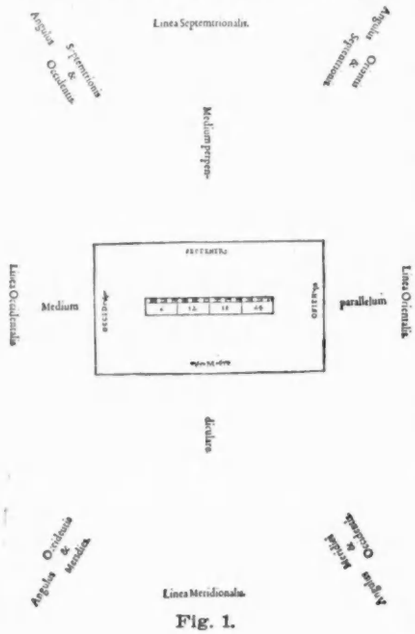


Fig. 1.

present work, without the permission of its author.

"Given at Orleans in the year one thousand five hundred and sixty-nine, on the twenty-seventh day of June

"By the King in Counsel.

(Signed) BRULLART."

Bessoni's book was not published until after his death, and was then edited by Franciscus Beroaldus, who seems to have had a peculiar, not to say comical, view of the proper method of describing a drawing and designating its several parts. Beroaldus seems to have regarded a drawing as a map of the ideas it was intended to convey. In his address "To the Reader" he says:

"Dearest Reader—As all human knowledge is designed for use and enjoyment, I have thought that this description of the machines, of which the plates present no small claim as clear representations, may contribute thereto; not only as an ornament to the library, but that it also may be able to furnish a means of restful, entertaining and delightful enjoyment.

"I therefore take pleasure in going on with this work, not only in clearly considering and describing the machines, but also; God willing, in setting forth briefly the mathematical theory applicable, not commonly given; which is not for persons deficient in skill in the arts to employ, but is for a teacher delightful.

"Without detaining you longer with such observations, I desire to explain the following idea of my own. I call the exterior margin of the leaf the East, the opposite interior margin the West, the top North, and the Bottom South.

"This is oftentimes a sure way of locating a place, and if not elegant, will nevertheless be found satisfactory in practice, but if not entirely so it should not be despised.

"For a better understanding see the next page, from the indications of which an intelligent meaning may be derived, and be perceived with delight."

The "next page" referred to is shown in reduced fac-simile, as Fig. 1. Beroaldus applies his method to the description of Bessoni's screw-cutting lathe, which is illustrated by plate 9 of his book (see Fig. 2). After having described two lathes for turning drunken ballusters, and intoxicated vases, which were probably regarded as beautiful in his day, he continues as follows: "The third method of turning is not lacking in ingenuity—it consists in cutting, by a gradual, or step by step, deepening, a screw which encompasses a round and solid body, as also one that is oval or conoidal."

"EXPLANATION OF FIGURE 9.

"I understand how to turn in a spiral line, and will, to accommodate, describe all things that facititate this method of turning; and for a more perfect comprehension it seems good to explain it in detail.

"Two posts 12 feet high stand erect towards the North; upon the Westermost at a considerable height a part of the work is supported. Between are three movable beads, of which the Western is the largest; and the others—in which, at the pleasure of the workman, a screw freely turns—are of equal size. The part exterior to the screw is fixed, and the interior screw (whenever in motion) is moved forward and back, as often as the iron instrument in the Western part of the machine is applied and removed. In the North, about eight feet above the lathe bed, is placed a shaft, on which, at its middle and ends, cords are wrapped. That which is in the middle is pulled by the hand of the workman, and is heavily weighted, and similar weighted cords are connected with each end of the revolving shaft before named; but the Eastern cord is wound about the extremity of the inclosed screw, which is thereby revolved; and the Western cord winds about a part of the intended work. It now remains to consider the movement of the iron instrument. In the construction of the instrument itself the artist is in error; for inside the upright beam there is a screw into which the cutting instrument is screwed, and by which it can be removed; but the moving parts are correct. A beam about 14 feet long placed parallel with the earth, and which can be moved by the foot of a man, has at its Eastern and Western ends two other similar but shorter beams fastened; there also appear above these two arms in which there are pulleys over which from the last-named beams a cord is passed;

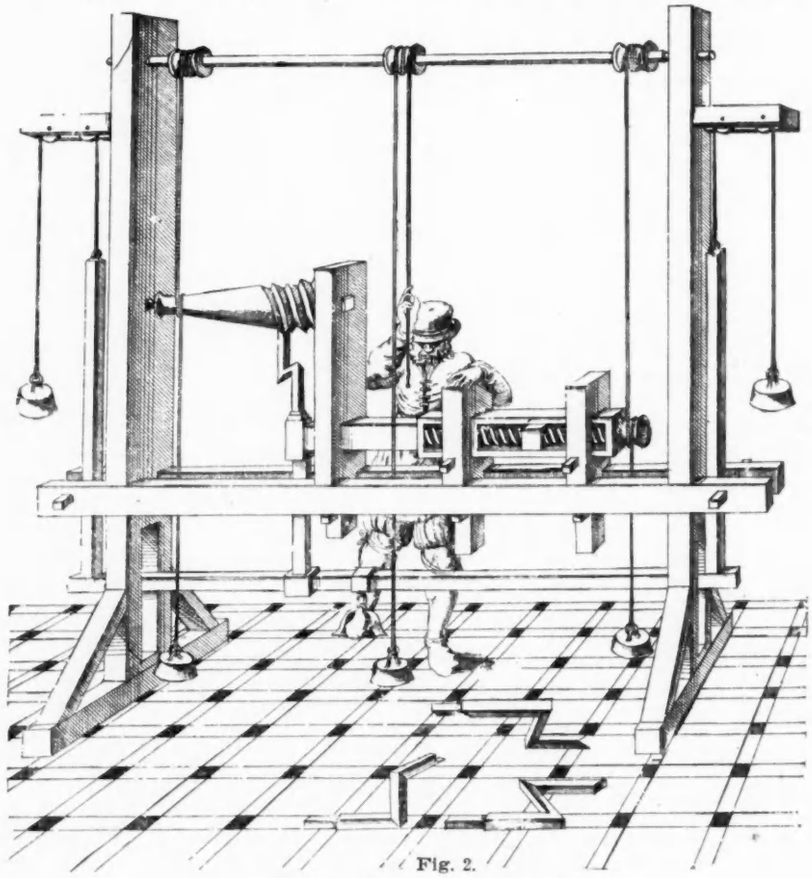


Fig. 2.

A SCREW CUTTING LATHE.

from each of which hang weights. This is explained by the figure."

The description is not very complete, for its writer omits telling us that the tool post must slide on the foot bar (at the South). The tools on the floor (at the South) have cutting edges of various shapes, and it will be noted that their shanks are square, which is said by our author to be an error of the artist. Most writers who have attempted to describe this lathe have supposed the guide screw was the one being cut, and the screw in the West (as Beroaldus would say) to be the guide screw; but the reverse of this view is the fact.

Boiler Efficiency.

BY W. H. WAKEMAN.

While reading the specifications for a certain boiler a short time ago, I made note of the fact that it must develop 160 horse-power while burning not to exceed 11.5 pounds of coal per hour per square foot of grate surface, that 10 pounds of water must be evaporated for each pound of coal burned, and that the boiler must be capable of developing 50 per cent. more power, or 240 horse-power, and not burn over 10 per cent. more coal to evaporate a given amount of water. The specifications meant that the loss of efficiency with rapid combustion must not exceed 10 per cent. Let us see what this means. Burning 1 pound of coal to evaporate 10 pounds of water where 30 pounds make a horse-power, gives us 3 pounds of coal per horse-power, or 480 pounds per hour when 160 horse-power are called for, or 720 pounds when 240 are needed. But the man who wrote those specifications recognized the fact that rapid combustion means a waste of fuel, as well as other evils. Under the former circumstances 3 pounds of coal are required; but if only 9 pounds of water are evaporated, instead of 10, then $3\frac{1}{3}$ pounds of coal will be needed, and $240 \times 3\frac{1}{3} = 800$ pounds of coal per hour.

If we are developing 160 horse-power, burning 3 pounds of coal per horse-power, per hour and 11.5 pounds per square foot of grate surface, then we must have

$$160 \times 3 \div 11.5 = 41.74$$

square feet of grate surface, and if we force the fire so as to burn the maximum amount of coal mentioned, it will mean $800 \div 41.74 = 19.11$ pounds of coal per hour per square foot of grate surface. In short, then, the idea is that if the amount is less than 12 pounds, we shall get very good results, but if it is raised to about 20 pounds a loss of efficiency will be the result. This I believe to be a correct principle, although the exact figures will vary with conditions, and one of the most efficient boilers now in the market has a record of evaporating but 6 pounds of water per pound of coal, where about 40 pounds of coal per hour per square foot of grate surface were burned.

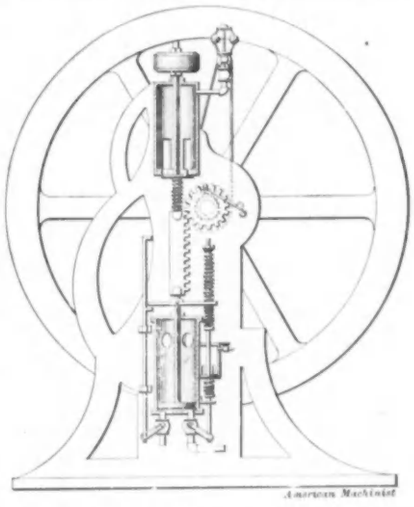
We are frequently told that where land is very valuable, it pays to put in a small boiler plant and then force the fires, because the interest and taxes will be much less than they would be were a more liberal allowance of boiler room made; but an examination of the premises where rapid combustion is advocated on this account, sometimes shows that much more space than would be required for a fair-sized plant, is occupied by old barrel hoops, piles of ashes, etc., and it is no uncommon thing to find upright boilers, that are impossible to clean and unhandy to use, installed in places where the land is sold by the acre, or at a low price per foot, and the claim presented that much floor space is saved by the adoption of a style of boiler that makes it advisable for the fireman to have a spyglass in order to tell where the water level is. Truly consistency is a jewel.

On exploring the engine-room of an old steam vessel a short time ago, I was impressed with the compact way in which the machinery was placed; for in addition to an engine whose cylinder was about 30 inches in diameter, there were two large boiler feed pumps, one fire and one bilge pump, one air pump with one steam and four air cylinders, and a large condenser, all in a room about equal to a space 26 feet wide and 30 feet long. It was, of course, too compactly arranged for convenience or comfort, but there it was necessary to economize room, and there was nothing to offset it. The boilers were set in two batteries in the usual way, and the distance from one front to the other was but 8 feet. Air was forced through the engine and boiler rooms by large fans, without which it was impossible to live in them. Here it was necessary to have a small plant and force it to its utmost capacity, and not a matter of choice. It is true that the power plants of many steamers are very efficient as a whole, but this is largely due to the engines, and not wholly on account of rapid combustion under the boilers.

Another "Greatest Invention of the Age."

Probably the most persistent objection to the gas engine is found in the means by which its speed is regulated. In order to govern the engine, it must be somewhat larger than required; and when it furnishes power in excess, some of the impulses of the engine are skipped. Rules will not always work well both ways; but it would be a strange rule, or a strange process of reasoning, that could not be worked backward by some peculiarly constituted mind. A genius—for he can be nothing less—has discovered that the most objectional feature of the gas engine may be a most desirable feature of a steam engine; and for the sake of using a steam cylinder intermittently, instead of constantly, an engine, of which we here reproduce a sketch, has been designed and patented, a model has been made and tried, the indorsement of "mechanical experts" has been secured, a stock company, with a capital of $1,000,000 has been formed—all combining to reveal the still latent possibilities of credulity remaining in this nineteenth century.

Referring to the cut, the lower cylinder is the steam cylinder, which does all the driving. The steam is admitted below the piston, and all the work is done on the upward stroke. The piston rod carries a rack, working into a loose pinion on the main shaft. The pinion carries a pawl which catches the rachet wheel fastened



to the shaft, so that, on the up stroke, the piston imparts its impulse to the shaft, and when the piston stops, the shaft continues to revolve. The piston rod is continued up through an air cylinder above, and carries a weight on its upper end. The steam cylinder has holes near its upper end, to let the air out when the piston rises; and when the piston passes these holes, an air cushion is formed. The piston in the cylinder above has a valve opening downward, so that all the air in the cylinder passes out through this valve, and when the piston reaches the top it is not permitted to return, on account of the vacuum above it. When the speed of the shaft drops, the governor admits air above the piston, and then it returns to make another stroke; and that is the way the thing is governed. The exhaust valve is on the left side of the cylinder bottom, and is operated by the vertical rod with the two lugs, which are occasionally knocked by the crossbar on the piston rod. The other end of the crossbar works the steam valve. This is not opened positively, but depends upon the relative tension of the springs above and below the crossbar. The valve rod is also provided with an air cushion, to check its too sudden closure.

Space will not permit us to enlarge upon the minuter details and beauties of this invention; but we doubt not that our readers will be able to discover them.

Bicycle Tools—XIV.

The Rudolphe & Krummel rim-driller indexing action, or "dial" action, previously referred to, is illustrated in Figs. 92, 93. These illustrations of this movement are given because an index action is often needed in automatic and semi-automatic tools, and this is an extremely good example and a very late construction.

The requirements of a table indexing action for automatic metal-working tools, such as presses and multi-spindle tools, working in sequence on pieces carried by the intermittently-rotated and locked table, chuck, or work-carrier, are as follows: The angular advance of the table at each step should be variable, and should be readily and certainly adjusted over considerable ranges of difference. The travel of the table at each step, for machines of the class indicated, may be required to cover any angle of rotation from 120 degrees down; and in some cases it is desirable to provide for a very ready change from one number of stops in a complete rotation to another number, half or twice as great as the first. The table must be rigidly locked after each step is made, and must remain locked until the indexing lever is again operated. There should be but one movement of a lever needed to unlock, rotate and relock the table in its new position. The movement of the action should be easily given through a simple treadle, as the operator often has both hands fully employed otherwise. The parts must in all cases be certain to act with rapidity; they must not be arranged so as to possibly cause an overthrow of the table; in almost all cases either destruction of the work or of the dial itself is the inevitable result of a failure in the index action. These conditions are all of them fully met in the arrangement of parts shown, and, in addition to meeting the necessities of the case, the parts are all simple and easy to make and keep in repair.

Fig. 92 is a partly rear view of the third design of the R. & K. rim driller. The drill-spindle angle-adjusting parts are very clearly shown, as well as the chuck indexing action. Fig. 93 is from a hand sketch, which shows a later design of the indexing mechanism than that used in Fig. 92. The action is, however, so nearly the same in both, that the two engravings, taken together, give a complete idea of the mechanism. A circular disk, provided with tapering index-latch receiving notches on its outer edge, is fitted with a key and set screw to slide on the end of the chuck-supporting shaft, which is fitted to revolve freely in a bored hub, cast solid with the frame. It should be noted that in no case can any indexing movement involving the use of a brake be made so certain in action as those in which the spindle is unhampered in turning. The brake not only makes the action heavy, but is difficult of uniform maintenance; and where used to avoid overthrow, is a frequent cause of disaster. The treadle chain, Fig. 92, is carried over and under an upper and lower idler, inside the frame, before leading to the left-

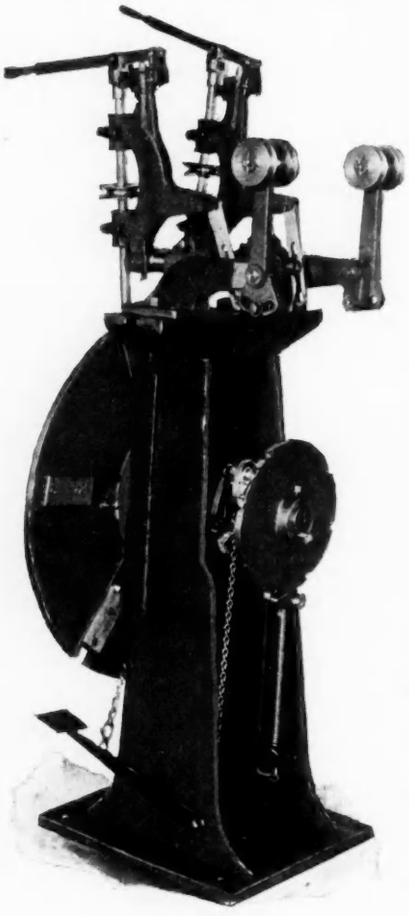
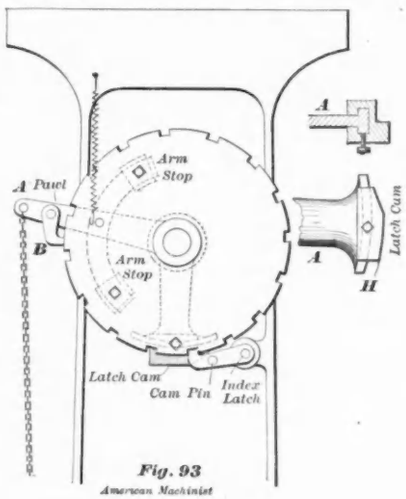


Fig. 92.

hand member of the bell crank *A*, Fig. 93, which has pivoted to it the spring-controlled pawl *B*, which has its tooth constantly influenced toward the index disk face by a spiral spring, as shown in Fig. 92. The extreme travel positions of *A* are governed by two arm stops, adjustable on a stationary dovetailed segment, as shown by dotted lines in Fig. 93. The upper stop is always set so as to cause the pawl *B* to stand out of the adjacent notch in the index disk. The lower member of the bell crank *A* is formed as shown in the detail cross-section, and has adjustably secured on its T, lower end, the latch-releasing cam, which can be adjusted on the T-end of the bell-crank; the index latch is pivoted to a hub in the frame, and is also provided with a spiral spring to keep its tooth as far as it can towards the center of the chuck shaft. The spiral spring pin extends through the index latch, and projects on the inside into the path of the latch cam. The bell crank *A* is provided with a long coiled spring, shown in Fig. 92, so arranged as to keep *A* always at the high stop, when not depressed by the foot of the operator.

As *B* does not rest in a notch, the latch cam can be so adjusted as to act on the cam pin, and release the index disk before the tooth of *B* drops into the index notch and begins to move the disk. The latch cam is made of such length as to keep the latch away from the index plate for the length of step required, and yet short enough to drop the latch on the edge of the index plate a considerable distance before the index notch reaches the latch tooth; and from the point where the latch is dropped on the edge of the index plate, a chordal cut is made in the plate, so that the latch will have time to drop down below the outer circumference of the index plate, and so arrest the index plate, instead of permitting it to make an over-travel from the momentum imparted by a quick treadle movement. This is a very important detail; and the exact cut given by R. & K. to their index disks is shown in Fig. 94, which is a quarter-size reduction of a rubbing from an index plate. The latch meeting side of the index notch is about ⅛inch higher than the leading side. Owing to the inadmissibility of the brake to absorb momentum, these proportions, from successful practice, are of prime importance to the designer. If the step is to be only from one notch to the next one, then the cam is made such length as to drop the latch in time to catch that notch; if more than one division is to be embraced in each step, then a longer cam is slipped on the T dovetail end of *A*, Fig. 93, to cover the required number of index notches, the arm stops being adjusted to give the increased travel to the pawl *B*, Fig. 93. When the treadle is at its low point, the whole movement of the action is complete, so far as movement and retention of the index plate is concerned; the index latch has been un-



INDEXING MECHANISM.

latched, the index plate has been revolved through its predetermined angle, and the momentum has been received by the end of the latch, and the latch has been dropped into its proper index notch. When the treadle has been released, and the arm

A begins to return the heel of the latch cam *H*, Fig. 93, must, of course, strike the cam pin in the latch, and lift the latch tooth out of the index notch, dropping it back into the notch when the bell-crank arm *A* reaches its high point of travel. This second lifting and dropping of the index latch is a blemish, but is considered less objectionable than would be a parallel

Fig. 94
American Machinist

ruler linked cam face, which would enable the latch cam to pass the cam pin idly in the up travel of the bell-crank *A*. In operation, the index latch has never once been known to fail to lock the index plate correctly when *A* was at its high position. Mr. Chapman, of Milwaukee, wood rim manufacturer, informs me that he has used his R. & K. rim driller at the rate of over three rims per minute; with 32 spoke holes, drilled with two drill spindles, this would give $\frac{32 \times 3}{2} = 48$ index actions per minute—a speed which sufficiently proves the excellence of this index action, when the very considerable weight of the rim chuck and its large diameter are considered. This would give 1,800 rims drilled in 10 hours; but it is not likely that any workman would or could maintain this speed for an entire day.

The tools used in the wood rim drillers vary very little in general design. Some factories make their own bits, which are commonly in the form of a combined boring bit and countersink; but these tools are more often, I think, purchased of manufacturers. Those made by Morris Wood & Sons, 31-33 South Canal street,

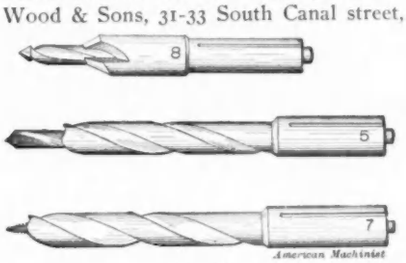


Fig. 95

RIM DRILLING TOOLS.

Chicago, Ill., are largely employed, and have some special features. These tools are shown in Fig. 95. The peculiar feature is the boring of the larger bit entirely through, lengthwise, so that the smaller bit or pointed screw-threaded rod can be slipped into the outer bit; this makes the two tools co-operative, but independent so far as repairs and renewals are concerned, and is a very valuable feature, as the leading screw of a bit is often damaged while the remainder of the tool remains good—but must be thrown away in case the screw forms an integral part of the bit. With the separate screw, the screw itself may be repaired, or replaced by a new one at small expense. The shank of the outer tool is split in three sections by three saw-cuts, one of which is shown in the engraving, Fig. 95; consequently, when the outer shank is tightened up in the chuck, the inner tool is clamped to the outer one.

After the wood rim is drilled, the next operation is to seat the washers in the countersinks made for them in the rim. The washers are of iron, are slightly cupped in cutting, and the countersinks are made a close fit on the washer edges. The washers are put in the countersinks by hand, and then rammed home by a stroke of a little hand press, as shown in Fig. 96, from Gormully & Jeffrey's fac-

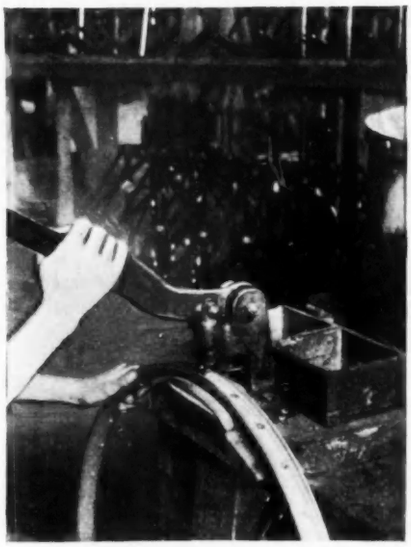


Fig. 96.

PLACING WASHERS.

tory. Fig. 96 gives such a clear picture of the concluding operation on the wood cycle rim, that nothing need be said of it in detail.

HUGH DOLNAR.

Testing an Injector.

BY W. H. WAKEMAN.

Some engineers seem to think that in order to make a test of even a simple appliance, it is necessary to have special apparatus, but this is not so in all cases, for many times there is material for this purpose around the plant that by the exercise of a little ingenuity may be made to answer every purpose, and the object of this article is to show how this was done in one case.

At a meeting of a certain engineers' association, the question came up concerning the difference in the amount of water that an injector would deliver under different conditions, namely, in one case the water was to be taken from a tank below the injector, and in the other it was to be supplied under pressure from the water mains. A difference of opinion existed, for while some thought that it would make a great difference, others thought that it would make none at all. Wishing to settle the question, for myself, at least, I made a test in the following manner. A platform scale was borrowed from a contractor's room in the shop, and brought down into the boiler room. An oil barrel was deprived of one of its heads, and set upon the scales. The barrel was nearly filled with water, the exact weight of which was noted. The weight was taken instead of measurement, for greater accuracy. The suction pipe of the injector was led into the barrel, the boiler pressure noted, the injector started up, and the time required to draw the water down as low as the pipe extended into it was carefully taken account of. Of course, the suction pipe would not take out all of the water, but it was an easy matter to take the weight of what was left. The time required to take up this water was carefully observed.

To get the time required to put the same amount of water into the boilers, when it was applied under pressure, was a little more of a job, but was soon accomplished by connecting the water pipe to the water inlet of the injector in the usual way, and a temporary delivery pipe was put up, on which was a small safety valve, which was weighted until the pressure in the delivery pipe equaled the boiler pressure, and this was injected into the barrel on the platform scales.

In this way the same conditions were secured as when feeding the boilers. The objection may be raised that much more pressure existed in the feed pipes than the steam gauge denoted, on account of long pipes, many turns, etc., but this was ascertained by a gauge on the feed pipe, and the same gauge was put on the temporary delivery pipe, between the injector and the safety valve. As the water in the barrel was now warm, instead of cold, as in the other case, it would be a little more bulky, but by taking the weight of it, this was taken into consideration. The boiler pressure in these cases was 70 pounds, the water pressure averaged about 25 pounds, the lift was two feet, and the difference in the amount delivered under the different conditions amounted to 22 per cent.

From this it will be seen that if an injector is not quite large enough for a certain place, where it is lifting its supply, it may answer the purpose if it is so arranged that the supply will be delivered under pressure.

Some may claim that if a boiler was fed by an injector that could take its supply in either of the above-mentioned ways, and the time required to fill up a certain hight in the gauge glass noted, that would be all that would be required; but this is not so, for such an experiment would be open to so many objections as to make it of no value.

A Turbine of the Niagara Power Co.

BY PROF. DE VOLSON WOOD.

The turbines of The Niagara Power Co. are of special interest on account of their great capacity and their romantic associations.

It has been proposed to utilize some 100,000 horse-power of the falls of the Niagara River, and already some of the grandest work in hydraulic engineering has been executed. A channel has been excavated for the purpose, some 12 feet deep and 250 feet wide, extending into the river, and a greater distance into the land, located about a mile and a quarter above the crest of the falls. This channel is tapped at several places, and the water conducted to vertical shafts, in which are cylindrical penstocks about 140 feet long, at the lower ends of which are turbine wheels, each rated at 5,000 horse-power. A view of one of these penstocks, the plan of the wheel, and the vertical shaft of the wheel (parallel to the penstock) for transmitting the power to a power-house above is shown in Fig. 1. This shaft is of unique size and workmanship. The main (or larger) part is a hollow steel cylinder, rolled, and without vertical riveted seam. It is 38 inches external diameter and ¾ of an inch thick. This tube is divided into three parts, joined by solid pieces 11 inches in diameter, which form bearing journals for supporting the weight of the wheel, shaft and attachments; these being supported by iron beams resting on the solid rock. One of these is shown in Fig. 2. The bearings are quite similar to the thrust bearings of the propeller shaft in ships. The tail races from the wheels lead to a tunnel 7,000 feet long, about 21 feet high, and 18 feet wide at the widest place, which discharges into the river a short distance below the falls.

An immense paper mill has been established near the upper end of the channel, which is driven by some parallel flow turbine wheels, and the Power Co. have placed two large turbines of the Fourneyron type, a plan of which is shown in Fig. 3. This is the design of Messrs. Faesch & Piccard, of Geneva, Switzerland, selected by the Niagara Commission from a large number of competitive designs. The figures on this plan are those accompanying the design. A vertical section of the wheel is shown in Fig. 4, in which *A* is the end of the penstock by which the water enters the casing *B*, through which it flows to the guides or distributors *bb*—three at the lower end and three at the upper—and through them to the buckets of the wheel *aa*. The buckets extend around the entire circumference and are thirty-two in number, and the distributors also are around the entire circumference—but there are thirty-six of them. The upper crown just above *d*, and the lower crown *h*, which carry the buckets *a*, are firmly secured to the shaft *c* so that the buckets, crowns and shaft must rotate together. Through the upper end of the case is an opening *d*, so that the water acting by upward pressure will support a part—or all—the wheel, shaft and attachments; but the lower end of the case is solid, while there is an opening *h* in the lower crown, for the escape of water, so that there will be no downward pressure. The lower end of the case is supported by rod *g*, attached to the body of the case. The gate consists of two rings *cc*—one at the upper end, the other at the lower — extending completely around and outside the wheel, and are opened for the outflow of water by being moved downward. The wheel being divided into six elementary wheels by horizontal partitions, and both upper and lower circular gates being operated by the same rods, the wheel can be run at one-third or at two-thirds its full capacity, as if there were three separate wheels. It is designed ultimately to place ten wheels of this character, of about 5,000 horse-power each, in one pit, or long slot, in the rock—all of which are to deliver their power in one power-house. There is a conical sleeve at the lower end of the case, not shown in the drawing, similar to the one shown at the upper end. Two of these wheels are now in place and operating. In Fig. 1 is shown a dynamo at the upper end of the shaft, for generating electrical power to be delivered to customers as desired.

The data for analyzing one of these wheels was obtained through the courtesy of Coleman Sellers, E. D., Professor of "Engineering Practice" in Stevens Institute, Hoboken, N. J., and "President and Chief Engineer of The Niagara Falls Power Co." The principal data are:

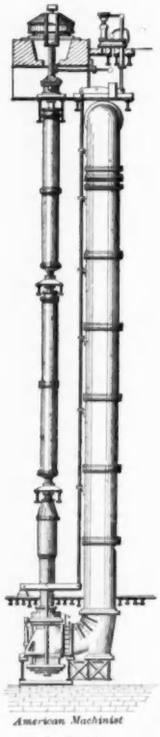


Fig. 1.

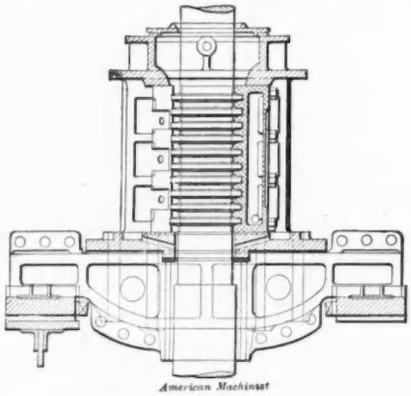


Fig. 2.

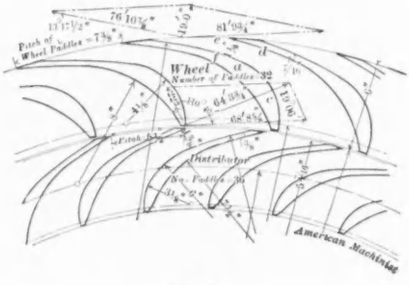


Fig. 3.

THE NIAGARA TURBINE.

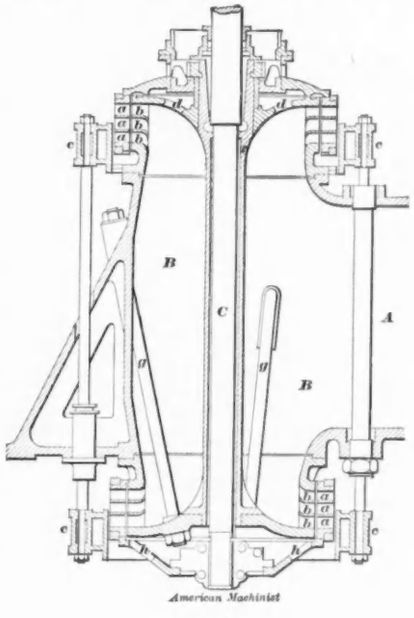


Fig. 4.

Outside diameter of wheel, 6.25 feet.
Inside diameter of wheel, 5.25 feet.
Fall, or head to center of wheel, 138 feet.
Total clear depth of the six buckets, 1.81 feet.

Terminal angle of guide, 19°.

Initial angle of bucket, 51°.

Terminal angle of bucket, 13° 17′.

Coefficients of friction of water, 0.10.

Outside diameter of tubular shaft, 38 inches.

Thickness of shaft, ¾ inch.

Diameter of solid part of shaft, 11 inches.

Clearance of wheel, 1-16 inch.

Diameter of cylindrical part of the penstock, 7 feet.

The head may vary with the hight of water in the river, and the head under which the wheel was tested was not known to the writer when the computation was made; the value, 138 feet, was taken as about the mean of the values given in popular articles. The head does not affect the efficiency, but will affect the capacity of the wheel. As will appear further on, the head assumed exceeds the actual by a small amount, but the difference will increase the capacity by less than ¾ of 1 per cent.

With the above data I made a computation of the performance of the wheel. This analysis involves long and complicated formulas, the contents of which are considered as too heavy for the readers of the "American Machinist," but the results may be of interest, especially if compared with those of a test experiment. I found:

Number of revolutions per minute, when running at best effect, 252.

Hydraulic efficiency, 83.4 per cent.

Efficiency referred to the water consumed, 80.53 per cent.

Volume of water per second flowing through the wheel, 433 cubic feet.

Leakage through clearance of the wheel, 16 cubic feet.

Volume flowing into penstock, 449 cubic feet.

Horse-power, 5,520.

Dr. Sellers made a test of one of those wheels, and from a communication I am permitted to make the following extract:

The head, from the upper surface of the water to the center of the wheel, at the time of the test, was 135.113 feet.

The volume of water flowing into the penstock, measured by many gages, distributed at as many points in the stream, was, per second, 447 cubic feet.

The theoretical power of this water per second was 6,864 horse-power.

The actual electrical power generated per second was 5,335 horse-power.

Efficiency of plant,

5,335 ÷ 6,864 = 0.7785; or 85 per cent.

If the efficiency of the dynamo was 97 per cent., as guaranteed by the manufacturers, then the efficiency of the water power delivered at the upper end of the shaft was 80.26 per cent.

And the horse-power delivered at that point was 5,500.

Before comparing these results, we observe that if the head due to the velocity in the penstock, 1.4 feet, be added to the measured head, we have 136.5 feet effective head, which is only 1.5 feet less than that assumed in our computation. In our computation we have not allowed for the friction of the shaft bearings. For this we made an approximate computation and found it to be about 0.3 per cent., but do not consider this very reliable; but if it be deducted from our efficiency it leaves 80.23 per cent., which is almost identical with that reported by Dr. Sellers.

Although these results are a strong confirmation of what can be done by theory in designing a turbine, the reader should be cautioned against supposing that results so nearly identical between theory and experiment can generally be obtained. In this case some of Dr. Seller's results depend upon the assumption that the efficiency of the dynamo was 97 per cent. Should it be shown by a test to be less than this, then the water efficiency of the wheel would be larger than 80.26 per cent.; and if more, then the efficiency of the wheel would be less. It is remarkable that the water consumption, 447 cubic feet as measured, and 449 cubic feet as computed, happened to agree so nearly; for it may be that the clearance is not exactly 1-16 of an inch, nor that the co-efficient of discharge is exactly 0.8.

There are inevitable errors of observation, and conditions which are assumed to be perfect may not be so; and for these reasons it is held that theory can give only approximations, more or less close, of what will be found in a test case. We found other results, differing from those, in Fig. 3, as follows:

Velocity quitting guide, per second, 54.5 feet.

Initial velocity in bucket, 21.3 feet.

Terminal velocity in bucket, 85.3 feet.

Velocity quitting the wheel, 19.6 feet.

Angle of quitting, 88° 53′.

Stress on the tubular shaft when the wheel is running steady at 252 revolutions per minute, and delivering 5,500 horse-power, 867 pounds per square inch.

Stress on the solid part, 5,260 pounds per square inch.

At the same speed and power the shaft will be twisted 4° 13′; or, in other words, a point 3 feet from the center of the shaft at the upper end will be moved about 2½ inches due to the twist.

Turbines have been run under greater heads. One of the earlier Fourneyron turbines at St. Blaise worked under a head of 354 feet, making 2,300 revolutions per minute; but it was only 13 inches outside diameter and developed only thirty horse-power. A turbine at Immerstadt, nearly 9 feet diameter, worked under a head of 570 feet, and with 210 revolutions produced 336 horse-power. Knoke describes turbines working under a head of 650 feet, outer diameter about 15 inches, developing 98 horse-power under a head of 131 feet, at 928 revolutions per minute. At Turin, Italy, in a steel manufacturing establishment, turbines 8 feet diameter, work under a head of 595.5 feet, developing 1,000 horse-power. This, and the two preceding wheels, had segmental feed. The capacity of the Niagara wheel greatly exceeds any of these, or of any others within our knowledge.

Lathes and Other Things, Here and Abroad.

BY JAMES HARTNESS.

The request for an article on the impressions received during my recent trip abroad would, doubtless, have been passed over with my best excuse, if it had not been accompanied by the remark that my refusal would indicate that nothing short of an offer to print a half-tone from my latest photograph would be a sufficient appeal to my vain nature to extract a technical article.

Being an American, and having spent all my days in the American machine shop, impressions received abroad were taken in by a somewhat prejudiced mind; but, at the same time, much was observed that gave evidence of the equality, in the mechanical field, of the cousins on the opposite side of the Atlantic.

Modern means for producing lathe work have so long received my special attention that it is quite natural for me to talk about the foreign types of lathes, and their efficiency as compared with our American lathes. The typical English lathe seems to have points of superiority over our American lathes—not, perhaps, as an all-round working tool, but for taking heavy cuts, the English lathe, of an equal swing to the American lathe, seems to do the best work. This, of course, was contrary to my expectations; but, after having observed the fact, the next point was to find the reason.

The principal difference seems to lie in the form of the carriage, and its bearing on the bed. The English method of fitting directly to a flat surface, instead of using the V's, seems to account for part of the difference—and then, the form of the carriage being such that the supporting part is directly front and back of the tool post; while, in the American type, the bearings of the carriage on the bed are quite remote, and the frailty of the American carriage saddle gives very little stability to the tool.

It is the common practice to fit the carriage to its V's at four spots—two on each side—and to protect the bearing surfaces from the falling chips. The English seem to disregard the question of chips on the bearing surfaces, in constructing their carriages, with the result that the bearing is almost directly under the cutting strains; hence, there is an absence of deflection of the saddle.

The inside V's on the bed of the Ameri

can lathe make it necessary to weaken the saddle at an important point in its section, and the almost universal practice of giving great swing over the carriage again reduces it from the upper side.

A glance at the carriages of these two lathes will bear out the statements made; and there seems to be no reason why the American lathe cannot be made stiff enough to outdo the English type, without losing any of its present points of advantage for accurate work and convenience of operation. There seems to be no good reason for retaining the inside V's, excepting the popular notion that they have always been there and should remain. It is an element of weakness, and has little value.

If our lathe carriages were proportioned to give the stiffest support to the cutting tool, I am confident that they would be in better demand abroad. After having stiffened the carriage saddle, it would be necessary to make a tool-holder of stiffer design than that in most common use on the American lathe, but as this point has already been met by many of the principal builders, it may be passed over without further mention.

American lathes ordered by parties abroad are invariably provided with a compound rest, and this is the cause of much dissatisfaction. Here, the compound rest is very little used, excepting for turning bevels But there, it is used on almost all operations; and because they are unable to swing it around to a position parallel, or nearly so, with the V's of the bed, without interfering with the foot stock, they are quick to condemn the construction of the lathe. With a compound rest, they want a foot stock that will clear the rest, when it is turned into its position at right angles to the cross-slide. It would be better for the American interest if the lathes were used abroad as they are used here—and that is, without a compound rest, excepting for work requiring the tool to travel for turning bevels.

Our lathes and machinery, in general, seem to be well liked and looked upon as the best for accurate work.

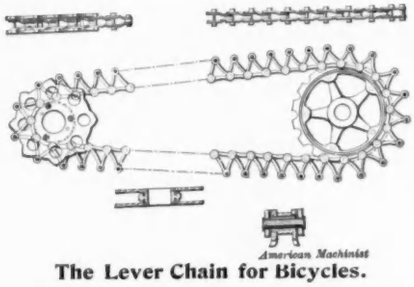
The English, and the tool-builders on the Continent, build an extensive line in each shop, instead of developing one machine, and putting some expense into its introduction on the market. They are ready to build anything that is called for by the customer, and the customer usually calls for something a little different from anything they have ever built. This method of working operates to the advantage of the American builder. The reasons for their adhering to such methods are exactly the same as those which we can hear in such shops in America.

It may be that the foreign builders' notions are correct on this point, but it does not seem so to me; for, taking the lathe business, for instance: Lathes are built in nearly every machine and tool-building shop in Great Britain and on the Continent. If one builder undertook to make the 16-inch and 20-inch lathes for all, by making a better machine and making it in large quantities, and at a smaller price, it seems to an American as if he would get all the business he could handle.

I am aware that there are American lathes with center bearings for carriage, and even with the foreign type of bed, and that there are many lathes of American design built abroad—that there are American builders abroad and foreign builders here—but all this against the rule is not sufficient to be taken into account.

Regarding the future demand for the American lathes in the foreign market, it would seem that it will continue as long as the builders on the opposite side of the Atlantic continue to build a little of everything in the same shop; and that as soon as the English and Continental builders get down to a manufacturing basis, making principally one size, to the exclusion of everything else, the demand will cease.

My friends may recognize in this article the "cloven hoof" of a flat turret lathe fiend, on account of the general line of criticism of the carriage used in other turret and engine lathes, also for the reason that I so strongly advocate manufacturing in the place of building; but facts are facts in mechanics, if they are not in politics, and the readers of this paper are quick to discern the difference between the good and poor designs and methods.



The Lever Chain for Bicycles.

A correspondent calls our attention to the so-called "lever" chain for bicycles, of which we reproduce a sketch. In passing over the larger sprocket wheel, the action of this chain is similar to that of any regular chain; but when this chain passes over the smaller wheel, the driving is done, or rather the contact of the chain with the wheel is upon a larger proportionate diameter of the wheel than with the driver; and on this account it has been thought by some that the chain was given a greater leverage and that "power was gained" by its use. It is to be remembered that while the chain is going around the small wheel, it is not doing any driving, but is simply inert. All the driving is done by the pull of the chain at the moment that it leaves the wheel, and in a line tangent to the point where it ceases to ride. Referring to the sketch, it will be seen that the final pull is done by the straight line of inside links, and in a line with the smaller circle of the wheel, so that the imagined increased leverage is only imaginary. The outer bearing studs of the chain help to carry it around the small wheel, but they do not drive. The ratio of the wheels shown is two to one, and if the sprockets were placed on the small wheel, similar to those on the large one, some of the outer rim of the wheel could be dispensed with and more than one-half of the chain, and nothing that we can see would be lost by the change. The small sprocket wheel, as shown, is double, and the chain drops in between the two sides, so that we judge that the weight of it must be at least double that of the common sprocket wheel for the same service.

Piston Valves.

BY W. H. BOOTH.

Piston valves have of late years come to the front; but it always seems to me that a fundamental error is made in their design. Because they are pistons it seems impossible for designers to get out of the notion that a piston must have loose packing rings, and so we see a piston valve made with loose packing rings that have to travel to and fro across port openings and take their chance of catching upon the sharp edges of the ports, from which accident they are only prevented by the bridge pieces that are left in the ports for that purpose. But if the piston valve be compared with the ordinary working piston, or, rather, if a comparative study of their working conditions be made, we shall see that they differ in a very material point.

The ordinary engine cylinder is free from openings or breaks of continuity of any sort, and the piston that works within it can be made steam-tight by all sorts of spring rings or loose packing pieces, for such are never allowed to travel beyond the smooth surface of the cylinder, and especial care is taken that they shall not enter the counterbore, where the rings could expand and lock the piston fast or even split the cylinder.

Now, the cylinder in which the piston valve works is full of gaps, and these gaps are simply bridged across for the purpose of enabling the packing rings to pass safely to and fro. The whole construction seems to be a mistake. For two surfaces working together, it is of great importance that, where there are loose pieces in one of them, one surface shall be continuous; and to place the piston valve in an equally advantageous position as the main piston, it is desirable that, as the port surface must have gaps in it, the surface of the piston valve should be continuous.

Now, it is a well-known fact that the slide valve, when properly made, will often work many years at the expense of a very small amount of wear, even when

it is exposed to quite a considerable pressure of steam. In the piston valve there is no such pressure, and there can consequently be but little wear. Yet it is very common to find men speaking and writing of the difficulty of keeping piston valves tight. That this may be so with ring-packed valves is very possible, but with a continuous body to the valve there is no such lack of steam tightness, and as the wear of a properly formed valve is very slight, as there is no heavy load of steam pressing it upon its face, it is obvious that a piston valve having only a small amount of expansion may remain tight for years.

As far back as 1850 there was invented a piston valve, the body of which was a plain smooth cylinder, in which a strong and stiff body had a single longitudinal cut which was closed by a wedge set up by a screw and double wedge combination, the attempt being made to use a wedge of some material more quickly worn away than the body of the valve, so that when set up it should not oppose much resistance to wear, though at the same time it should maintain a joint past which steam should not leak.

In such a solid-bodied valve as this it is not a difficult matter to first rough-turn the casting to a diameter somewhat greater than the finished diameter, and then to encircle it with a clip that will compress it to a smaller diameter after the cutting of the longitudinal division. If, then, in its compressed condition the covers of the valve be ground in place and the closing wedge be fitted, it is easy to clip the covers on so tightly that the valve will not open even when the clips are removed, but it can be again placed in the lathe and finished to the exact diameter of the cylindrical shell in which it is to work. Such a mode of construction, giving an initial elasticity, avoids, for years perhaps, any heavy duty on the part of the expanding wedges and screws, for the valve remains tight by its own elasticity. Moreover, being a continuous surface, it cannot cause accident by catching upon the edges of the ports. The ports in such a valve are openings, several in number, cut through the cylinder which forms the seating, and separated by bridge pieces, usually, in plain plug valves, placed in an inclined direction. But such piston valves are usually given a slight rotation about their longitudinal axes, to assist in maintaining perfect circularity, in addition to the to-and-fro movement for steam distribution, and it was probably this rotary movement that led one inventor to devise a means of cutting off steam with a piston valve by an automatic gear, the rotation of the valve being then effected by a separate eccentric or by a rapid cam motion, and the effect aimed at being secured by adding to the steam edge of the plain plug valve a series of projecting wings which, in one position, do not cover the ports, but, when rotated through a small angle, will do so. By the application of a differential gear in the train of mechanism between the crank shaft and the expansion cam itself, the striking time of the cam is put forward or backward by the action of the governor, and variable cut-off secured thereby.

The wearing qualities of such a solid-bodied valve are perfect, and I can only attribute the complaints as to other piston valves, to the neglect of the essential point, viz., that on a gapped surface the other surface in sliding contact should be continuous.

Modern Methods of Manufacture, Here and Abroad.

The following, from an English periodical, "Invention," was evidently for home consumption, and has a different flavor from much that is produced for export:

"As we read the reports of our Consuls from every country with whom we have relations, we are struck with positive amazement at the supineness with which we seem to have been seized. There was a time in the world's history, not so very long ago, when the mere fact that an article of any kind was made in England was a patent, as it were, of nobility. We then set the standard of excellence for the world. Now we can think of no parallel which will apply, except that of the Chinese, who, at one period of their national existence, attained a pre-eminence in government, science and the various arts, and then stopped short, satisfied with the efforts they had made, setting their standard of excellence by the degree of perfection to which they had attained, and quietly ignoring the fact that the world existed outside of the limitations of their own territory. They assumed, with a stupidity we cannot but wonder at, that what they had achieved had no further capabilities of expansion or improvement, that what they had done was the best that was possible. But the world moved on, and the Chinese nation became a back number. Is it not possible that we, relatively speaking, occupy to the rest of the world the position which China has occupied; that, in our smug complacency, we still regard English manufactures as the best, and vaunt to ourselves the fact that 'Made in England' is all we need stamp on our goods and manufactures to insure them a place amongst the best that the world can provide? A nation which reaches such a condition as this needs a lot of teaching; and before our manufacturers wake up to the fact that they are no longer the makers of the best articles the world can supply, we shall need a still greater amount of instruction than we have already acquired.

"England is, in her machinery, ideas, manufactures—in short, in everything which can be produced by the skill of man, supplemented by machinery—already a back number among the nations. She is rich enough to stand the drain for a time; but as surely as the world exists, as progress extends, so surely is the ground being cut from under our feet by the enterprise, skill and invention of other nations. The Germans, the French, the Americans, and last, but not least, the Japanese, are rapidly supplanting us in the markets of the world, with goods not only cheaper, but absolutely, side by side, irrespective of price, better than any we can furnish. It is about time that England awoke, shook off the sloth, the crass stupidity, we may say, of her present attitude, pulled herself together, and admitted the fact that, in the words of the immortal Jasper, 'the world do move,' and re-established her precedence as the producer of the best."

Although the above puts Americans in the category of England's dangerous, and already more or less successful, competitors, the lesson of it should not escape us. If the English are beaten, or if we are beaten, we are to be defeated with our own weapeons. The methods that have brought us success are correct, as far as they have gone. Some impression has prevailed concerning Germany, and especially as regards Japan, that cheap labor is the secret of successful competition. The secret is not in cheap labor, but in cheap production; and cheap production means the most efficient machinery and the most perfect organization. Japan is cutting into the industries of civilized nations by learning every detail of these industries, and giving attention to the most minute economies. Germany is familiar with the most perfect methods of production, and is refining them continually; and while she is cheapening production, we need not believe that she is cheapening the producer.

It will be remembered that in our article referring to the Kane-Pennington engine it was stated that the workmanship on this engine was very ordinary, and, to judge from a letter by Mr. E. J. Pennington, published in our London contemporary, "Engineering," of December 27, 1895, the workmanship of the engine has been criticised over there, for he says: "With reference to the workmanship of our motors, I am very willing to admit that work done in England is in quality superior to what is done in the United States." So far as we can see, there can only be one object in making such a statement, and that is to create the impression that the Kane-Pennington motors made here were made as well as they could be made in this country, which we have good reason to believe is by no means the fact, and such a statement by Mr. Pennington does an injustice to American machine shops.

ELECTRICAL MACHINERY.

Electrotechnics—IV.

The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

12. THE ELECTRO-MAGNET is the foundation stone of commercial electricity, as will presently appear. Nevertheless, all writers and authorities on electrical science invariably introduce the

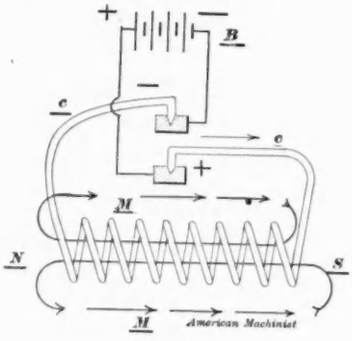


Fig. 12
A SOLENOID.

vehicle preceding the motive power, when defining and explaining the principle of this most important device—beginning with dissertations on and descriptions of permanent magnets, which have little commercial importance; passing thence to iron magnets, excited by electric currents in coiled conductors; thence to magnetic manifestations of such coils, minus their iron cores; and, finally, exploiting the magnetic field which co-exists with every electric current, and which is the beginning and the because of all electro-magnetic phenomena.

An electro-magnet is defined as—"A core of magnetizable substance, as soft iron, which is magnetized by the passage of an electric current about it, and ceases to be a magnet when the current ceases."

As a matter of fact, the coil without the core is an electro-magnet. Such a coil is shown in Fig. 12, in which *B* is a battery and *C* a coiled conductor, suspended from mercury-filled cups so as to swing freely. *M M* are the magnetic lines, so-called. *N S* indicate the resulting polarity. A coil so suspended will, when carrying a current, place itself north and south, attract or repel another magnet, and attract iron. Not only is this true, but any conductor, coiled or straight, during the passage of an electric current, is an electro-magnet, and will attract or repel another conductor, or any other magnet, and will attract iron. A single turn of wire will exhibit the same polarity and other properties as a coil; though, of course, for the same current more feebly. Such a turn is shown in Fig. 13, suspended from Ampere's table.

13. THE MAGNETIC FIELD. The space about a magnet, within which the magnetic influence is discernible, is termed the magnetic field. If magnetic needles or iron filings are introduced within the field, they tend to arrange themselves end to end, in certain definite directions, forming a series of closed or continuous curves. Hence the term "magnetic lines." In the presence of other magnets, these lines are distorted, according as they are repelled or attracted. They will also seek the path of least resistance, and conform to the disposition of the conducting material, just as will the electric current, and just as water seeks its level, resisted by the elevations and conducted by the depressions of the earth's surface.

The form of curve of the magnetic lines in the field about a single conductor, is the circle, the center of the conductor being the center of the circles, and the lines forming an invisible sheath about the conductor, the existence of which can be optically demonstrated by dusting iron filings upon a surface perpendicular to the conductor, as upon a piece of cardboard through which the conductor passes. This is illustrated in Figs. 14 and 15, in the former of which the direction of the electric current is from the observer, while in the latter it is toward the observer. These lines, as has been noted, are assumed to have a direction of motion, to flow just as the electric current is considered as flowing, and are sometimes termed the "magnetic whirl." The

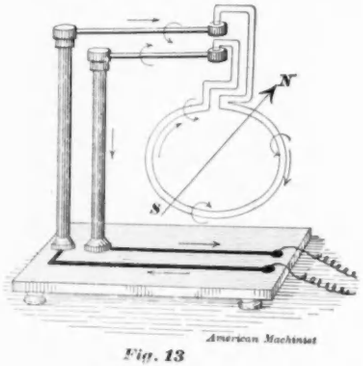


Fig. 13
AMPERE'S TABLE.

direction of flow of the magnetic lines has a fixed relation to the direction of the electric current in the conductor. Thus, if an electric current is flowing through a conductor, from the observer, the whirl is said to be to the right hand, or in the direction of motion of the hands of a watch (Fig. 14). This for the reason that, if a magnetic needle be introduced within the magnetic field, the northern pole will point, or be deflected, in the direction specified, it being further assumed that, in all magnets, the lines flow through the body of the magnet, from the southern pole to and out of the northren pole and return through the magnetic field to and into the southern pole. There is, however, no real reason for supposing the flow to be in this direction, any more than the reverse; or any proof that there is any flow. Like the assumption of flow and direction of the electric current, it is a convenient convention, and nothing more. Returning to the field of a single conductor, if the direction of the electric current is reversed—that is, if it is toward the observer—the

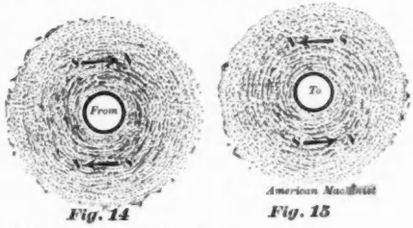


Fig. 14 *Fig. 15*
LINES OF FORCE ABOUT A CONDUCTOR.

magnetic whirl will be reversed and become left-handed (Fig. 15).

This influence of the electric current upon a magnetic needle, is the phenomenon observed by Oersted in 1819. An examination and study of Fig. 1 at this point will prove instructive. Upon the principle involved in the above, are constructed the receiving instruments of submarine cables, and many instruments of precision.

14. THE DISTORTION of the magnetic field about adjacent parallel conductors, varies with the direction of the electric current. Thus, if in opposite directions, the magnetic whirls, being also in opposite directions, repel each other and tend to push the conductors apart, just as a pair of elastic rolls tend to push apart (Fig. 16). But if the currents coincide in direction, so also do the whirls, which thereupon unite and flow about both conductors, just as do open belts over pulleys (Fig. 17). Manifestly, the strength of the magnetic current about two such conductors is twice that about either conductor by itself.

Upon placing a third similar conductor beside the second, all the magnetic whirls will coalesce, and a magnetic current of triple strength will flow about all three conductors—and so on indefinitely. Thus, there is apparently no limit to the strength of the magnetic field which may be created. Nor would there be, but for the fact that the magnetic lines, like the electric current, require a conductor, and the best available offers some resistance. Owing to such resistances, all of the lines of a whirl do not join in the general swim, but some continue about individual conductors, or "leak" and take a short cut back.

This tendency may be seen in Fig. 17. The strength of the magnetic field is furthermore limited by the strength of the electric current flowing through the conductor, and the latter, as we have seen, is limited by the working resistance of the conductor; this, in turn, being practically determined by the degree of heat which the insulation can safely withstand.

15. A SOLENOID. A conductor, of insulated wire, wound in the form of a helical spring, is termed a "solenoid." A little consideration will make it clear that, if a current is passed through the spiral, it will flow, side by side, in the same direction through all the turns. Thus, in Fig. 12, which represents a helix of right-

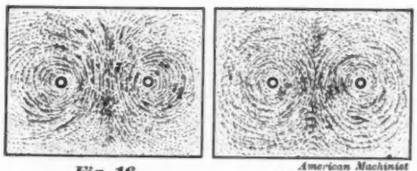


Fig. 16 *Fig. 17*

LINES OF FORCE ABOUT PARALLEL CONDUCTORS.

hand pitch, if the current enters at the right-hand end, it is evident that the direction of flow will be from the observer at the top of each turn. Hence, as we have seen in section 13, the magnetic whirl will here be right-handed—viz., to the right, over the top of the coil, and into the right-hand end. It is further evident that the direction of flow of the electric current will be toward the observer at the bottom of each turn. Hence, as again seen by §13, the magnetic whirl will here be left-handed—viz., to the right, under the bottom of the coil, and into the right-hand end. In short, viewed from any point, the flow of the magnetic lines is to the right, over the exterior of the coil, and into the right-hand end. There is, so to speak, a magnetic draft through the coil from right to left.

This constitutes a true electro-magnet (§12), has a northern and southern pole, and will place itself in the magnetic meridian if freely suspended (Fig. 12); the left-hand end pointing to the north, since, by §13, the magnetic lines flow through the body of a magnet, from the southern pole to and out of the northern pole, returning through the magnetic field to and into the southern pole. Note that the northern pole of the magnet is attracted by the north pole of the earth, but is repelled by the northern and attracted by the southern pole of another magnet. This paradox is made clear later.

If the electric current in the solenoid is reversed, the polarity will reverse. If the pitch is reversed, the polarity will reverse. But if both the current and the pitch are reversed, the polarity will not reverse, since the current still flows from the observer at the top of the coil. Note that it is the direction of flow of the electric current which really determines the polarity, and not the pitch or winding.

To avoid confusion, it is customary to speak of the same properties of the electric and magnetic circuits in different terms; thus, "magnetic reluctance" expresses "resistance," "magnetic flux" expresses "flow," and "magnetic lines" expresses "current." "Reluctance to the flux of the magnetic lines" and "resistance to the flow of the electric current" express similar ideas.

The rule for determining the direction of flux of the magnetic lines, when the direction of flow of the electric current is known, has been given (§10). If the direction of flux of the magnetic lines is given to determine the direction of flow of the electric current, the rule is, as a matter of course, an exact parallel, viz.: If the observer is looking at the southern pole of an electro-magnet (the flux of the magnetic lines through the magnet being from the southern pole, as above, and, hence, from the observer), the electric current will flow to the right hand. But if the northern pole is toward the observer, the flow of the electric current will be to the left-hand (Fig. 18). Compare this rule with the one above-mentioned.

A screw of right-hand pitch is a material embodiment of this rule. If the [screw current or whirl] turn to the [right hand], the corresponding [motion flux or current] is [from] the observer. If the [screw current or whirl] turn to the [left hand], the corresponding [motion flux or current] is [toward] the observe.

It may be well to state Ampere's rule, since it is a famous and favorite expression of the above facts. Suppose a man to be swimming in a conductor with the electric current, and that he turns so as to face the magnetic needle (Fig. 1); then

Fig. 18

LINES OF FORCE ABOUT MAGNETIC POLES.

the northern pole of the needle will be deflected toward his left hand. Applied to the magnet, the rule becomes: Suppose a man to be swimming through the magnet, toward the northern pole; then the current in the wire, as he faces it, will be to his left hand.

CORRECTION.

In the article of this series appearing in the issue for January 9th, the following errors occur:

§ 7. "$HP = \frac{746}{EC}$ (5)" should read:

$$HP = \frac{EC}{746}.$$

§ 8. "$HP = \frac{746}{EC}$ or $11.9 = \frac{746}{98 \times 64}$ (5) § 7" should read:

$$HP = \frac{EC}{746} \text{ or } \frac{1}{11.9} = \frac{98 \times 64}{746}.$$

The Polyphase System in Europe.

The "Electrician" (London) for December 27th, 1895, published the first translation into English of a paper read by Prof. Galileo Ferraris, March 18th, 1888, before the Turin Academy, in which the Tesla polyphase system of motor is apparently anticipated.

The paper is entitled "Electro-Dynamic Rotations Produced by Means of Alternating Currents," and was published about two months prior to Tesla's complete English specification. It is relied upon in Europe to break Tesla's patents. The experiments described were, at the time of publication, already old, having been made in 1885. Professor Ferraris describes, with surprising clearness, the production of a rotating magnetic field by means of an alternating current; and it is difficult to see how the conclusion can be avoided that, so far as Europe is concerned, Tesla's patents are anticipated by this paper. This, however, is not the case with this country, where Tesla's patents were taken out enough earlier to anticipate this publication.

It is interesting to note that so clear-headed a thinker as Professor Ferraris was befogged, as so many were in times past, by that one-time bug-bear—Jacobi's law. This law states that the output of a motor is at a maximum when its efficiency is 50 per cent.; and Professor Ferraris, by failing to note the difference between maximum and the economical output, condemned his own brilliant offspring to strangulation by assuming the two to be identical. He is not, however, the first one to have been befogged in this way. The error was rife in the early days; and we well remember a labored discussion in support of it, by one of Mr. Edison's assistants, in the winter of 1879-80. The argument at that time was applied to the output of a dynamo, and was based on the well-known law that the maximum output of a given number of battery cells, against a given resistance, is obtained when they are so arranged that the external and internal resistances are equal. Mr. C. F. Brush seems to have been about the first to discern the difference between maximum output and most economical output.

Summing up this view of the case, Professor Ferraris says: "These calculations and experimental results confirm the evident à priori conclusion that an apparatus founded upon this principle cannot be of any commercial importance as a motor." In other words, he deliberately abandons his invention as a commercial machine; and yet this paper will apparently serve to rob Nikola Tesla of the fruits of his labors. Such has been the history of

patents since patents have been, and such, apparently, will it continue to be, until the patent laws recognize that the man who does something, and puts an invention before the world for the world's benefit, is the man who is entitled to patent protection, and not the mere speculative dreamer, who suggests, but never accomplishes.

The Field for the Storage Battery.

Our criticism of last week on Messrs. Abbott & Dommerque's contribution to the storage battery discussion, outlined in a general way the field which stands open for a successful battery; but it seems worth while to describe this field more fully.

There is a widespread impression that the chief applications of a successful accumulator would be to street cars, as a substitute for the trolley, and to horseless carriages. It is, of course, probable that a successful battery of sufficiently light weight would find a very large field of usefulness in these lines; but it is nevertheless true that these applications are not the leading ones toward which the thoughts of engineers are directed.

As our article of last week indicated, there is a great economic need of such an appliance, in connection with central stations for the supply of current for lighting or trolley car service, which a very brief study of the conditions attending such services will make clear. The leading condition which brings this about, is the great fluctuation in the demand for current for either of these purposes. In the case of lighting circuits, the great demand for light is, of course, during a few hours of the evening; this demand beginning gradually as darkness comes on, rising to a maximum, and then declining as evening activity ceases. In the case of street car service, there is usually a somewhat similar, though smaller, daily variation; but other causes of variation exist in car service which overbalance, and in many cases largely wipe out, this daily variation. These causes are the irregular stopping and starting of cars, and especially the arrival of cars at the grades at more or less regular intervals. In other words, the principal variation with lighting circuits is comparatively gradual in character, and occurs but once per day; while, with car circuits, the variations are almost instantaneous, and occur many times per day.

The nature of the demand for current in lighting circuits is shown in a typical diagram, Fig. 1, which represents the combined output for the London stations for December 20th, 1894.* The vertical parallel lines represent hours of the day, as noted at the bottom; while the horizontal lines, by their distances from the base line, represent kilowatts of electric power. The irregular curved line, by its varying distance from the base line, represents the varying output of current.

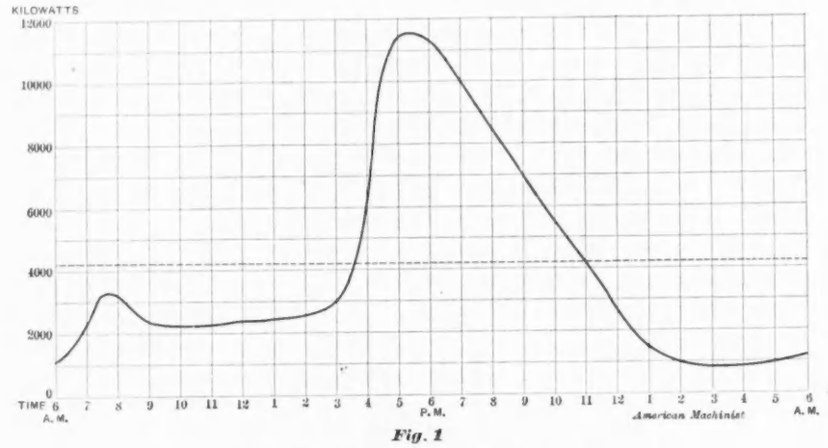


Fig. 1

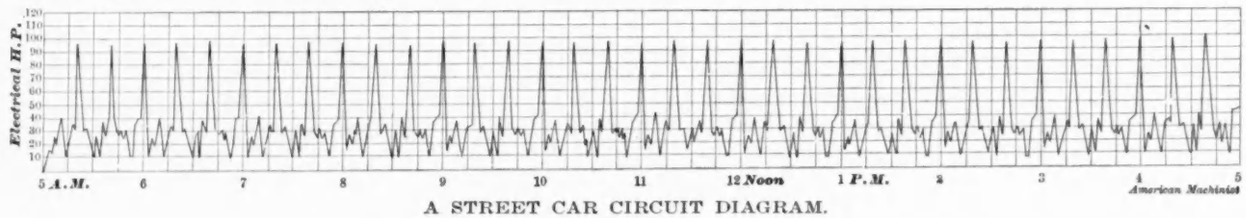
A LIGHTING CIRCUIT DIAGRAM.

The great irregularity in this output will be seen at a glance, the horizontal dotted line representing the average of this output.

A similar exhibit for a street railway plant is shown in Fig. 2, from which it will be seen that the maximum demand for current arises at regular intervals of twenty minutes, due to the arrival of a car at a steep grade at that interval. Unlike the lighting circuit, the car circuit diagram cannot be taken as typical, there being, in fact, no such thing as a typical car circuit diagram; each electric railway having conditions of its own which determine the form of its diagram, while in the case of lighting circuits, there is, of course, universal similarity of general condition. Those who have read Mr. Mason's articles are aware that the kilowatt is the unit of electric power, and is equal to approximately 1.35 horse-power. In other words, if measured by a different scale the diagrams would give the horse-power as well as the current supplied. This will make apparent at once the enormous fluctuations of load to which dynamos and the engines driving them are subjected. Our readers do not need to be told that this condition is fatal to high steam economy and to small repair bills. It has, however, another and equally serious aspect, namely, that the capacity and cost of the machinery, both electric and steam, must be equal to delivering the maximum output, and then be operated during the greater portion of the time at far less than that output. In the case of the London diagram, the maximum output called for during a single hour only is about 2¾ times the average; and this, it will be remembered, is for the 20th December, when the conditions are the most favorable of the year. It has been determined that the maximum load in London is about six times the average for the entire year.

It will be seen at once what immense value an effective, reliable and cheap storage battery would have. Such a battery would act like a water-works reservoir, or a gas holder, and enable electricity to be accumulated throughout the day, and be used as needed. The machinery would then require to be of a capacity equal to the average demand only, and it would be operated under a continuous, steady load. Even this statement, however, does not exhaust the advantages of an effective storage battery, as applied to central station work.

In the case of water-power plants, especially car circuit plants, it is found impossible in many cases to regulate them automatically. This arises from the slowness with which water-wheel governors act, in consequence of which the



A STREET CAR CIRCUIT DIAGRAM.

*For the diagrams presented with this article, we are indebted to the Transactions of the American Institute of Electrical Engineers. The diagram from the London lighting stations was presented by Messrs. Abbott & Dommerque, and is the one on which their calculations were based. The car circuit diagram was presented by Mr. B. J. Arnold, and appears in the same discussion.

machinery does not respond to the changes in the demand as quickly as it should. This often necessitates an extra attendant, with his hand constantly upon the gate, and his eye upon the voltmeter. With an effective storage battery, all this would be changed. Again, such a battery would make the supply of the current no longer dependent upon the machinery being kept in constant motion, the battery being able to carry the entire load during brief stoppages of the machinery from any cause.

It must not, however, be supposed that the case is entirely one-sided, even from the ideal economic stand-point. A certain expense of maintenance must be expected; and, moreover, the storage battery is no exception to the universal rule, that any transformation of energy is accompanied with a loss—an efficiency of about 75 per cent., or, in other words, a loss of about 25 per cent, being about what is considered to pertain to these appliances. This, however, is not as serious a factor as it at first sight appears, as the entire current does not go through the battery, but only so much of it as will equalize the load on the machinery, and supply the surplus or "peak" of the current. It must be borne in mind, also, that, in order to reduce the capital expenditure for a plant, the cost of the batteries must be less than the cost of an equivalent dynamo plant; since, if the money must be spent, it might as well go for machinery as for accumulators.

Enough has been said to demonstrate the enormous importance which a successful and cheap electric accumulator would possess, and it is not surprising to find it a leading topic of discussion among electrical engineers.

An Electric Current Rectifier.

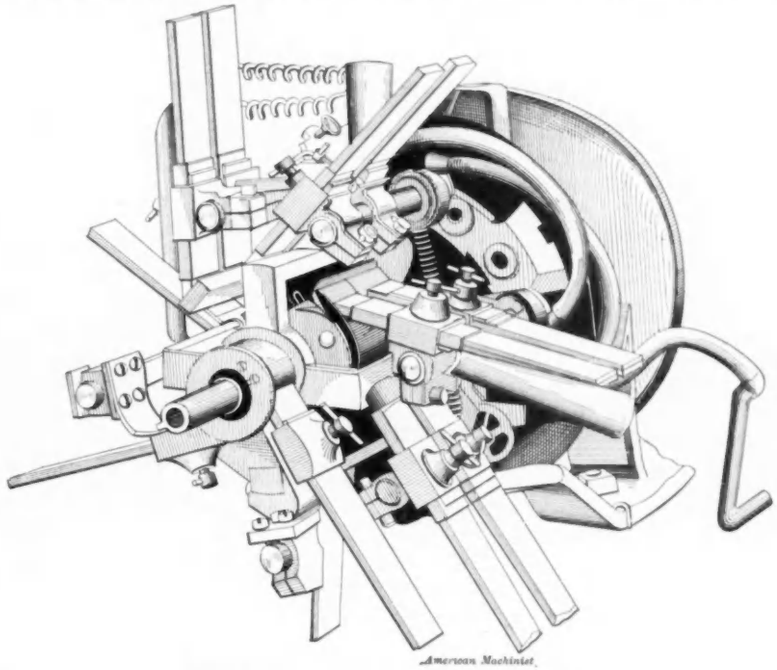
As is well known, the current generated in the armatures of all dynamos is an alternating current—that is, it flows first in one direction, and then in the other. In direct-current dynamos a commutator is added, by which these alternating currents are turned about as they leave the machine, and, in the external circuit, flow constantly in the same direction. An alternating dynamo is essentially one in which the commutator is omitted, so that the alternating currents pass on to the line as they are generated in the armature. The alternating current has the highly valuable property, which the direct current has not, of being capable of being "transformed" at will—that is, changed in pressure or voltage, either upward or downward. High-pressure currents require a smaller conductor than low-pressure ones, to carry a given amount of energy; and when the length is great, the use of high-pressure currents effects a marked saving in the cost of conductors. On the other hand, the use of such currents involves increased danger; and it is here that the value of the property of being transformed comes in.

When on main conductors, strung high in the air or buried in conduits beyond anyone's reach, the current may safely be of high voltage; and then, when a connection is to be made for a consumer, where the current is to come within range of doing harm, it may be transformed to a low and safe voltage. This is, in fact, the system on which alternating currents are distributed for incandescent lighting—a transformer being supplied for each consumer; the pressure on the house side of the transformer being low, and that on the street side high.

The simple alternating current, of whatever pressure, has, however, certain drawbacks. Thus, it is not so well adapted as the direct current to arc lighting; it is not at all adapted to electrotyping, electroplating, or charging storage batteries; and it has certain shortcomings when used for transmitting power. These are due to the fact that the speed of an alternating motor is determined by the "frequency" of the alternations, just as this frequency is determined by the speed of the generator. That is, the speed of the motor must keep time or "synchronize" with the dynamo. Except at this speed, the motor has no tendency to turn; and if when running, the load on the motor be increased, so as to check the speed, the motor will at once stop. Worse than this, perhaps, such a motor will not start itself, but must be brought up to the required speed by other power, before it will "take hold."

Several attempts have been made in Europe to overcome these drawbacks of the alternating current, of which, however, no very full particulars have reached this country. One of the most recent of these is by Mr. C. Pollak, of Frankfort, Germany, who has brought out an appliance for this purpose called a "Rectifier." This rectifier has been applied to the central station system at Frankfort, where it is as apparently successful as it is certainly very interesting. For the information on which the following description is based, we are indebted to the advance sheets of the January number of the Consular Reports issued by the Department of State at Washington:

The current, as generated and supplied to the distributing mains, is a simple alternating current; and, as such, it is used, through a reducing transformer, for incandescent lighting, in the usual way. For a customer who requires a direct current, the rectifier is used, its office being to take the alternating current from the main, through a transformer, and deliver it a direct current, as required. Two transformers are connected to the main; one being of such capacity as to furnish the volume and pressure of current required by the customer—this current being, however, still an alternating one. The second transformer is a small one, and supplies only enough current to operate the motor of the rectifier, which is a small alternating motor, having no other duty than to turn a commutator, through which the customer's current passes. This customer's current enters the commutator an alternating current, and leaves it a direct current, and the work of the rectifier is accomplished.



ELECTRICAL CURRENT RECTIFIER.

Of course, the motor which operates the rectifier must "synchronize" with the generator, like any other alternating motor; but, once started, its operation would be continuous, no excess of load could come upon it to stop it, while, being

small and having no mechanical load, it could readily be brought up to the required speed, when being started, by hand power. The whole arrangement is one of those simple and obvious devices which it would now seem should have come to the surface long ago. The limitations of the simple alternating current are well known and serious; and they seem to be removed by this device, giving the advantages of both alternating and direct currents to the same system. If the currents can be successfully handled at the commutator, it appears to us that the device may very easily become of commanding importance. We add an illustration of the machine, taken from the Consular Report, which, however, is not as clear as could be wished.

It is interesting to note that the invention was called out by the increasing competition which the incandescent electric light is experiencing from the incandescent gas light. In the words of the report:

"The rapid extension of incandescent gas lighting during the past two years, its comparative cheapness and high degree of brilliancy, added to the now demonstrated possibility of changing its tint by varying the combination of oxides in the incandescent mantels, have combined to check somewhat the adoption of electric lighting in Germany, and to force electrical companies to seek new outlets for their energy in the directions of motive power and electrolysis. The central electrical system established at Frankfort a few months ago has proven technically successful, but private consumers generally complain of its high cost, and it is already evident that the financial success of the enterprise will depend in future upon the more general adoption of electricity for motive and electro-chemical purposes.

"These conditions have lent exceptional importance and interest to a device known as 'Gleichrichter,' or rectifier, invented by Mr. C. Pollak, a Frankfort engineer, which solves the hitherto stubborn difficulty of converting an alternating into a direct electrical current with a loss of but a trifling percentage of its energy. The invention herein described bridges, therefore, an industrial difficulty which has become more and more serious with each step of progress in transmitting electrical energy over long distances from the place of generation."

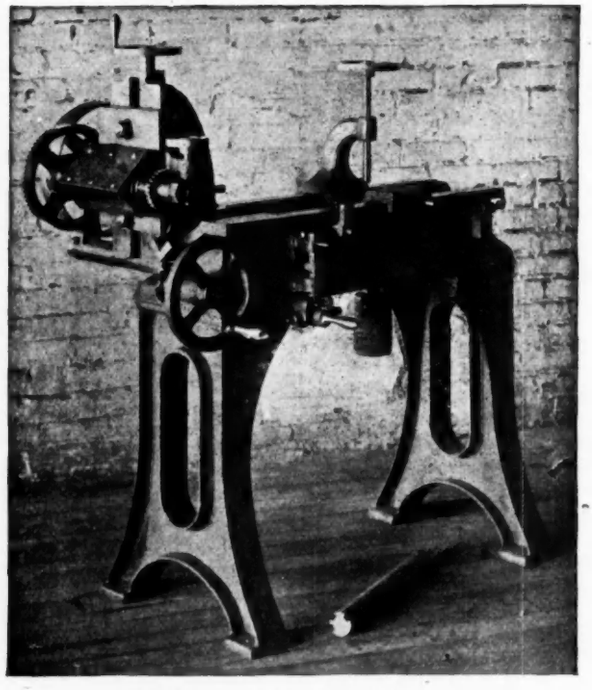
The author of the report, Mr. Frank H. Mason, Consul-General at Frankfort, is to be congratulated upon the clearness of his description, which, for a technical subject, is beyond what could be reasonably expected from such a source.

Key-Seat Milling Machine.

We give herewith an engraving of a machine designed especially for milling keyways in shafts.

The upright which carries the spindle slide is cast solid with the bed, and when the cutter is sunk to its proper depth, clamping bolts tighten this slide to the upright, and the machine is thus made very rigid, and capable of taking heavy cuts rapidly. A pair of expansion links allow the spindle to be moved vertically, without altering the tension of the belt. The table is automatically fed, and has an automatic trip which can be set at any point. The top of the table is made of a V form, which greatly facilitates setting the work, and adds to the certainty of results. By loosening the clamping screw and running the table back, key seats of any desired length can be cut; 20 inches being the length of the automatic feed. The carriage is adapted to take shafts from ¾ inch to 4 inches in diameter, and has a quick return motion by hand.

The machine may be furnished with index centers which will take work 5 inches in diameter and 20 inches long, and a vise can also be supplied. This machine is made by John T. Burr & Son, Kent avenue and South Sixth street, Brooklyn, N. Y.



KEY-SEAT MILLING MACHINE.

LETTERS FROM PRACTICAL MEN.

The Machinist and the Theater.

Editor American Machinist:

In your issue of December 5, 1895, appears an article under the above heading; and although, taken as a whole, the article should, perhaps, stand without comment, it appears to the writer that something should be said to give the so-called "theatrical machinist" his just dues, and it would be difficult for a person who is not, in a degree, acquainted with the range of ability required by the position in question, to form a correct idea of the amount of credit deserved by persons filling this position for the manner in which their work is executed.

In the first place, while all will agree, no doubt, that "machinist" is hardly correct as a name for the man who has charge of the mechanical effects on the stage, yet we are confronted with the question, "What shall we call him?" and it is, indeed, a difficult question to answer.

He must have some of the qualifications of the engineer, for the many platforms, staircases, and, in fact, the entire scenery, require stability in their own regard, and the power to withstand the weight of hundreds of people at one time; but all must be so constructed that it may be quickly taken apart and folded into a small space. This one particular alone combines engineering and mechanical ingenuity in a deserving manner.

I have no doubt that the writer of the article referred to objects as much to long waits between acts as the average patron of the theater, and when he does not have to endure them, he does not appreciate what is going on behind the curtain during that short time; and from his remarks I judge that he has seen very little of the rear end or a theater, for had he, he would be better acquainted with the workings of it, and would know that machinery is used during every performance, and a large amount of it during every spectacular production.

True, there have been many representa-

tions of the waterfall scene that tend to remind one of a sprinkling pot; but, on the other hand, there have been a number of clever reproductions of it.

It must be remembered that there are many things preventing the extensive use of machinery on the stage, other than the inability of the machinist to adapt it to the purpose. A design for some mechanical effect that would require two or three days to make ready for operation, would not be considered by theatrical managers. It must not require more than two or three hours at most, and the fact that it must be arranged to occupy a small space again limits the designer.

I regret that the writer of the previous article did not appreciate the horse-race scene, and believe him to be in the minority in not doing so. He admits the effect to be mechanical, and that machinery was used in its production, but "fails to see any mechanical invention involved." He must remember that plays are generally founded on everyday occurences, and admit only of effects reproducing everyday occurences; and if he can suggest a better or more complete method of representing the horse-race, or any other effect heretofore attempted, he will find many who are eager to hear of it, and who will produce it if practicable.

He "hopes to see the machinist do much better," and the machinist hopes so, too, which every season's effects show; and the fact that his salary is equal to about three times that of the ordinary machinist, goes to show that some people appreciate his efforts.

However, it is hardly proper to call him either machinist, carpenter, engineer or artist; but each one of these occupations furnishes a part of what he is required to know and be able to execute.

C. B.

Chicago.

[We tender our sincere apologies to the machinists of the stage. We recognize them henceforth as worthy members of our common craft. We trust that they will all be constant readers of the "American Machinist," and we will gladly welcome anything of interest that they may have to offer.—Ed.]

Standard Core Prints.

Editor "American Machinist":

In the issue of December 19th Mr. J. M. Richardson writes an article on stock core prints. I think the idea good, and that it should be adopted in every shop. I would suggest for a standard, say ½-inch taper in 1-inch length. For example, say a print is 1¾ inch at base, it would be 1¼ inch on top if 1 inch long. It would save the trouble of hunting up templates, which are so liable to get mislaid or lost, and in such case save the time of finding the necessary degrees.

With regard to cores being made to standard rule, Mr. Richardson's statement is misleading. It is all right for light, small work, but for average work I have found it different.

We will take, for instance, a plate 4 feet long, 2 feet wide, 1½-inch thick, and we core out the center, our core being 2 feet by 1 foot, which will leave us a frame when cast, the pattern being made by the ⅛-inch shrinkage rule, and the core by standard rule. Mr. Richardson would find our opening in frame 23¾x11⅞ inches, when cast; not that the core shrinks, it does not, it burns away, allowing the metal to shrink equal.

I know of a case where they make the core larger than the shrink rule calls for, in pipes, which they are compelled to do to secure the area required. Where would we be with standard rule there? I must admit there is a great difference in core sand; some use the loamy sand, while on the lake shore they use principally lake sand. But, on the average, the shrink rule I have found to be the most reliable for cores.

GEO. WASS.

Milwaukee, Wis.

Belt Drivers versus Shaft Governors.

Editor American Machinist:

Your article in December 26th issue, under heading "Engine Governor as a Safety Device," opens for discussion a very interesting and very instructive subject, as well as offering a timely warning to both the manufacturers and purchasers of engines, not alone steam engines, but also gas engines. Gas engine governors differ in both construction and operation from the steam engine governors. Their duty and mode of operation call for a very accurate and sensitive governor, which alone constitutes the principal, if not the most important detail of construction of the gas engine. In the steam engine, should the governor belt break, the valve will not open; but in the different makes of gas engines if the belt brakes or flies off, the result is different. Instead of closing the valve or cutting off the supply of gas, the cam, or movement which operates the governor valve, is usually held in such a position as to allow the engine to take its charge continuously, and consequently the result is a great increase of speed, so as to make it dangerous to approach the engine. An instance of this kind happened in this city, which was called to my attention some time ago, in which the governor belt of a certain make of gas engine broke, and the engine "ran away." The regular attendant of the engine, not being near the engine at the time, noticed the increase of speed, and, going to the engine room, saw what had happened. He would not go near enough to the engine to shut off the gas supply, but ran to the meter in the shop, and shut off the gas there. As the gas engine is generally without any constant attendant, the danger of this class of governor is clearly set forth. For electric light purposes I heartily endorse your sentiments, "The belt-driven governor is unsafe," and you might have added, "Does not give the steadiness of power" which is required for that purpose. In a recent test of a gas engine manufactured in this city, and tested by an electrical expert, the engine was subjected to a very severe test of its governor, which is a shaft or fly-wheel governor, and of exceedingly sensitive action. To give an off-hand description of the test (which was not what you might call an "official" test), I will state that there were no preparations for the test, but the engine was taken from the stock and put on the bare floor with a cellar under it, and no foundation of any kind, except the shipping skids, and not even screwed to the floor, nor fastened any way. The dynamo was also set upon the same floor, close enough to the engine for a belt and driven without any screws attaching it to the floor. After running some time, the electrician asked the superintendent if he would trust to his governor to have the entire load thrown off at once, and then thrown on, all of a sudden. He said, "Let her go," and he did. The 160 lights, which was the full capacity of engine, were thrown off and on several times, and the volt meter registered but a variation of from 1½ to 2 volts at the instant of change from 160 to 1 and from 1 to 160 lights. Everybody was surprised with the result; even the customer, whom they were trying to sell to, was satisfied, and the result was an order for an engine to run a 400-light dynamo. If such a test had been given an ordinary belt governor, it is hard to predict the result. After witnessing such a test, my convictions are still further strengthened in favor of the shaft governor for reliance, safety and steadiness of power.

T. C. KENNEDY.

Dayton, O.

The Kane-Pennington Motor.

Editor American Machinist:

I have been greatly interested in your article on the Kane-Pennington motor, and also in letters which have recently appeared in "London Engineering," on the same subject. The description given by Mr. Randol in your issue of January 9th is very clear; but there are a few points which might be explained still further. Perhaps Mr. Randol can answer some of the following questions, which are suggested by his article, taken in connection with statements made in some of the letters in "London Engineering":

1. What fraction of a horse-power was developed by the bicycle and tandem motors, when suspended by rope and running 1,500 revolutions per minute? Is not the power developed so exceedingly small that a very small amount of fuel would be needed to develop it—so small that the cooling of the cylinder by radiation is sufficient to dissipate the heat not

transformed into work, without the need of a water cooler? Does it follow, from this test, that a water cooler would not be needed if the motor developed its full power?

2. In the tests of November 20 and 22, 1895, of the 2½ x 12-inch motor, why was not the Prony brake shown in Fig. 4 used, instead of a board "held up by hand?" Why was no attempt made to measure the quantity of oil admitted per stroke, nor to ascertain the actual work done? What are the "circumstances which need not be detailed here," which "made more complete tests impossible"? Mr. Randol's diagrams seem to prove the accuracy of his statement, that "the charge was fired at the end of the stroke and by the first spark," and that "the deflagration was made instantaneous and nearly perfect." If this is true, is it not impossible that the double spark can have any special value?

3. Mr. Randol says, concerning the test with the "Regan" gas engine: "This was the test which I was assured would convince me that the 'double spark' fully doubled the power of a good common gas engine." Mr. Randol was, of course, not convinced of anything of the kind; but why was this test with the Regan engine made—an engine not designed to work without a carburetter, and a test apparently designed for the purpose of making a poor diagram, like that of Card No. 6? If a fair comparison is to be made between the effect of a double and a single spark, on a "good, common gas engine," why was not such an engine taken and diagrams made, with different kinds of sparks applied at different portions of the stroke? Again, why is a diagram like Card No. 6 produced to compare with that of the Pennington motor, when diagrams much more nearly like that of the Pennington motor can be obtained from ordinary gas engines? In the test with the Regan engine, with the single spark, why was the production of the spark timed so late in the stroke, which, as Mr. Randol says, is the "worst of all possible errors"? Why was it not delivered "just before the end of the charge-compressing piston stroke," as Mr. Randol says it should have been?

4. If there is any virtue in the double spark, or in what Mr. Pennington described as the "long, thin spark," is it not the case that the double spark and the "long, thin spark" are commonly used in all forms of gas engine in which electric igniters are used, and in which the spark (or sparks) is made by sliding of one piece of metal against another?—and, if so, in what respect does the operation of the Pennington igniter differ from that of other electric igniters? If the double spark and the "long, thin spark" have any special merit, in what does their operation differ from that of the igniting gas jet or the hot-tube igniter used in the earlier gas engines?

5. The igniter of the Kane-Pennington motor thus being in no essential respect different from the igniters of other gas and petroleum engines, in what does the Kane-Pennington motor differ from other gas and petroleum motors? Is there any other difference except (1) that its cylinder is made of a steel tube instead of cast iron, in order to obtain lightness; (2) that the cylinder is made longer in proportion to its diameter, so that there is a greater extent of surface for radiation for a given volume of cylinder than in other motors; and (3) that it is so small a motor (the bicycle and tandem motor) that radiation into the atmosphere is sufficient without water-jacketing, to keep the temperature of the outside of the cylinder down below red heat?

6. In Mr. Randol's first account of the Kane-Pennington motor, he said that a motor weighing 17½ pounds generated 4¾ horse-power; in other words, that the motor weighs only 3.7 pounds per horse-power. In "Engineering" of December 13th, page 740, it is stated that the Kane-Pennington motor taken to England weighs about 20 pounds, giving 2 horse-power at 500 revolutions per minute, or 10 pounds weight per horse-power. Was there some mistake about the original statement of a 4¾ horse-power motor weighing only 17½ pounds? Did Mr. Randol see the 4¾ horse-power developed, or what proof is there that it was developed? If the original statement was correct, why does the engine taken to England weigh more than 2¼ times as much per horse-power?

7. Why is it that the wonderful statements which have been made public, both here and in England, concerning the merits of the Kane-Pennington motor, have never been substantiated by the publication of the report of tests made by disinterested experts? Have any such tests been made? MECHEN.

Brazing—Furnace for Heating Brass Tubes.

Editor American Machinist:

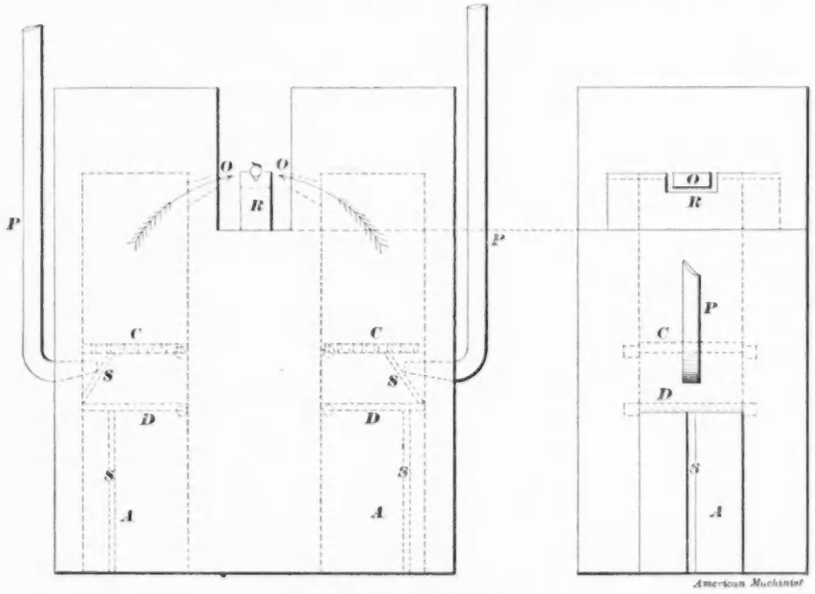
In a late issue of your esteemed paper, a "Constant Reader" calls upon "Quaker Brazer" for some information about brazing brass tubing. As I have had some experience in brazing, permit me to give it to those of your readers who may regard brazing as worth knowing.

When you have an odd job which is to be brazed, clean your parts well, make a tight joint—a good tight joint is necessary to make a good job, and oftentimes a mechanic makes a failure of brazing by not fitting his parts tight together. When the nature of the work permits, pin it or dovetail it; when this cannot be done, good binding wire may be used. It must in all cases be put together in such a way that it will not open the joint during the process of heating.

Next have a clean charcoal fire, with a good bottom, so that the cold blast will not strike the work; put some borax on the joint to be brazed and heat partly, then apply brass or copper with a little more borax; watch it well, for the borax will pop and is apt to fall off. Heat your parts slowly and evenly till the brass begins to flow, which can be seen distinctly by the appearance of a little blue flame; remove your work carefully from the fire and allow it to cool slowly.

It is a very good plan to give your work a moderate hot pickle bath, to remove all scale and borax, although this is not an absolute necessity. It is furthermore good to roast your borax before using; it will prevent it from popping and falling off your work while in the fire.

The foregoing is the general manipulation on the open forge, when only a few pieces are to be brazed. Illuminating gas is very good for heating small work,



BRAZING FURNACE.

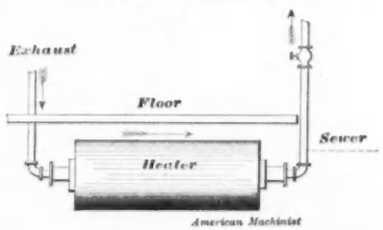
but is certainly very expensive for large work. When there are a good many duplicate parts to be brazed, it will be advisable to build a furnace adapted to the particular work.

Brass for brazing iron and steel is composed of 56.7 copper, 29 zinc, and 14.3 tin.

For brazing copper, bronze and brass, 45 copper and 55 zinc.

Cold-drawn brass wire or sheet brass is very good for iron and steel, but in all cases avoid using brass which is used for brass castings.

"B. B. M." wants to know the best way to heat brass tubing; permit me to give a description and sketch of a furnace that I would build, had I to do the job. Build the base of common brick about to grate, then use firebrick; grate surface 10x12 inches, depth of fire 8 inches. The draft will force the heat through the openings (which are about 2x3 inches), as indicated by the arrows, and will heat tubing very quickly. *R* to rest the tubing on has a V groove lengthwise and a gap sidewise. Keep one or two bricks loose on top, to feed the furnace. *C*, grates; *D*, drop; *S*, support for grate and drop; *P*, blowpipe; *A*, ashpit. Grate and drop fall down to allow the furnace to be cleaned. L. K.



The Location of Condensers and Feed-Water Heaters.

Editor American Machinist:

An accident recently occurred on a non-condensing engine that should be a lesson. The engine exhausted through a feed-water heater, which was located beneath the floor, as shown in the diagram, and the exhaust pipe, on leaving the heater, passed up vertically out of the building. The passage of the exhaust steam was therefore in the line indicated by the arrows. The heater was also below the level of the sewer, the level of the latter being indicated by the dotted line, and into this sewer the exhaust pipe was drained, and, as a consequence, the heater and the portion of the exhaust pipe below the floor formed a pocket for the collection of water. The engine was being started, and before turning a half-dozen revolutions, the throttle valve was shut in order to make some adjustment. The engine had not run long enough to force the water out of the pocket, and immediately after shutting the throttle, the water was drawn up into the vacuous space in the cylinder, produced by the motion of the piston, and the result was the destruction of the cylinder.

Of course, the remedy would consist in having the level of the heater higher than the sewer, thus avoiding pockets.

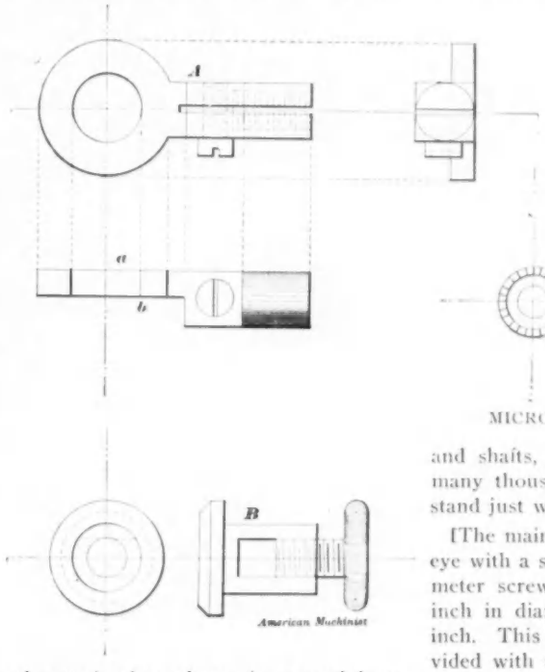
Another accident, resulting from the use of a condenser improperly managed, comes to mind. The condenser was located on the same floor as the engine, and it was of the independent type. The exhaust pipe from the engine passed down beneath the floor, then horizontally a few feet, finally rising through the floor and entering the condenser at the top. This arrangement of piping formed a pocket for the collection, and, as afterward proved, it was the cause of the destruction of the engine. The engine was slowing down, after the throttle valve had been closed, preparatory to stopping, and, according to the custom of the engine driver, a small quantity of air was admitted into the condenser, to reduce the vacuum and make a quicker stop. He carelessly admitted too much air, and the vacuum in the condenser was almost wholly relieved; whereupon the vacuum in the cylinder of the engine, which was still acting, drew the water which lay in the pocket of the exhaust pipe backward up into the cylinder. As soon as the piston reached the end of its stroke it came in contact with the solid body of water, and the disastrous results which followed were inevitable. The engine driver, in this case, was not so much at fault as the person who designed the plant. The condenser, of course, should have been placed below the level of the engine, so that all the pipes would have drained by gravity and have left no pocket.

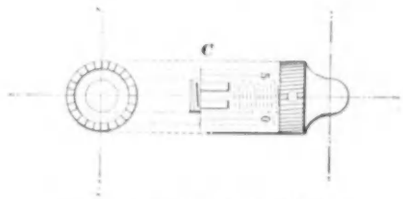
Boston, Mass. B. F. ZELL.

A Micrometer Attachment for Calipers or Measuring Rods.

Editor American Machinist:

I send you a sketch of the micrometer I have been using for three or four years, and I find it a handy tool. It can be used on inside or outside calipers or on a rod of any length as long as the end will slip in the square hole in the clamping bolt. As you see, I have the covered screw, and I have often wondered whether I was infringing on any patent of that kind. If I am, it is ignorance on my part. I am so used to this little tool I would be lost without it, because when we make pressing fits, or fits on propeller wheels and shafts, I have just to say allow so many thousandths, and the men understand just what is wanted. TRV.





MICROMETER ATTACHMENT.

[The main piece, *A*, consists of a large eye with a stem which carries the micrometer screw. The stem is tapped 3-16-inch in diameter and 40 threads to the inch. This end is also split and is provided with an adjusting screw to secure the proper fit for the micrometer screw *C*. The cap of this screw is graduated with 25 divisions so that it will read to thousandths like the familiar micrometer caliper. The clamping bolt *B* passes through the large eye in the piece *A*, the head of it resting against the side *a*, then the caliper leg, or rod, or whatever the caliper is to be clamped to, comes against the side *b* and is clamped by the thumb screw. The end of piece *A* with the micrometer screw may be set to stand in any direction desired. The large eye should have more offset than is shown in the drawing in order to bring the micrometer screw central with the caliper leg.—Ed.]

A Third Triangle for Draftsmen.

Editor American Machinist:

Of course, no draftsman of modern times could get along without his triangles of 30° and 45°. It would be difficult, perhaps, to determine which of the two was the most indispensable. With the two standard triangles, and, of course, a T-square and a rectangular drawing board, the circle may be divided into 24 equal divisions, or any multiple of 15° may be obtained. Every draftsman, however, does not know that the addition of a third triangle to his kit would enable him to divide the circle into 72 divisions, or to produce an angle of 5°, or any multiple thereof. Such, however, is the fact. Who knows of or is using the third triangle? TECUMSEH SWIFT.

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Every correspondent, in order to secure attention, must give his full name and address; not necessarily for publication, but as a guarantee of good faith.*

☞ *All communications for or relating to the reading columns should be addressed to the editor. All other communications to the company, as above.*

☞ *Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

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This number of the "American Machinist" is issued from its new publication office at 256 Broadway, which is a few blocks above the former location and facing City Hall Park.

By this change we are much more conveniently and more pleasantly situated, and shall be glad to welcome our friends to our new home.

Commodore Geo. W. Melville has been reappointed by the President, as Chief of the Bureau of Steam Engineering, United States Navy, and will thus enjoy the distinction of having served four successive terms in that position, a record which is unparalleled in the history of the bureau, but which all who have noted his career, and his management of the affairs of the bureau, will believe is well merited.

Another Case of Electrical Strabismus.

A will-o'-the-wisp of which we are beginning to hear again, is the electric bicycle lamp, with its miniature dynamo, driven from the front wheel. A moment's consideration will show the promising nature of this scheme.

Assume, to begin with, that ten ordinary 16 candle-power lamps, or a total of 160 candle-power, are obtained with the expenditure of 1 horse-power. If the bicycle lamp is to have, say, 10 candle-power, 1-16 of a horse-power will be required to operate it. In point of fact, an apparatus of the small size required for the purpose would be less efficient than this, but the figure named will be sufficient for the present purpose. Now, 1-16 of a horse-power is $\frac{33000}{16} = 2{,}062$ foot-pounds per minute. Assume the rider to be ambling along at a gait of six miles per hour—that is, a mile in ten minutes. In these ten minutes, $2{,}062 \times 10 = 2{,}0620$ foot-pounds of work must be done, to keep the lamp burning; and if we assume the rider and his machine to weigh 175 pounds, work equivalent to raising this weight $\frac{20620}{175} = 118$ feet must be done. In other words, under the conditions named, driving such a lamp would be equivalent to mounting a constant grade of 118 feet per mile. If this is too much, take a smaller lamp—"you pays your money, and you takes your choice"—but you pay dearly for your whistle in any case. Then, again, to one who is not entirely devoted to the advancement of the great and glorious new science of electricity, it would seem that the variation in brilliancy of the lamp with every change in speed of the machine, would be a fatal objection; but, of course, to your true electrician this would be a mere bagatelle. The fact that he had no light when picking his way slowly over a rough or dangerous road, while his lamp blazed out in full power on a piece of perfect asphalt, would amount to nothing. We must be expected to make some sacrifice for our favorite science, you know. If a thing can be done with electricity, that is the way to do it, regardless of objections; and the man who points out such trumpery difficulties as the above, is an incurable old fogy and a traitor to the cause.

Factors in the Production of Low-Priced Foundry Work.

Many of our readers will doubtless remember an article published in our issue of September 12th, 1895, in which an account was given of a foundry and its methods, in and by which work was turned out at prices below what are usually regarded as living rates for the best-equipped foundries, notwithstanding the fact that the foundry in question was shown to be anything but well equipped. Not only this, but its superintendent expressed himself as being satisfied with its equipment, and of the opinion that entirely too much money was spent by other establishments in special tools and facilities—especially Eastern establishments.

At the time, some of our foundry friends expressed the opinion that the apparent low cost of the work was due to a defective cost sheet; and this view is sustained by the fact that sundry executions have recently been levied against the concern, by creditors who have been contributing of their substance to supply deficiencies, no doubt, resulting from the absence of what are called "modern facilities."

It may do in some cases to go without modern appliances, and ignore the experience of others; but the man who does so must be sure that his cost sheet tells him the facts.

The weight of testimony is to the effect that brute strength will not take the place of brains in shops operated in this day of finesse; and creditors certainly cannot long be depended upon to take the place of modern methods and modern equipment.

We regret to notice in the January number of "Industry," an announcement to the effect that the present publishers will not hereafter publish the journal, and intimating that it may be discontinued entirely. We regret this. John Richards has made the magazine interesting and valuable.

We notice in some of our English contemporaries, the advertisement of a most responsible firm, which reads as follows: "Fuel consumption in actual work, under one pound of coal per indicated horse-power per hour, when working with producer gas." The cut of the forty horse-power engine accompanying the advertisement, indicates a size which in

a steam engine might mean five hundred horse-power, instead of forty; so that the cost of the engine is, presumably, decidedly higher than that of a steam engine of equal power. There is, of course, no boiler; but the apparatus for generating the gas, the cost of operating the same, and the transmission of the gas, are all to be considered in the computation of the final power cost.

Literary Notes.

HEATING AND VENTILATING BUILDINGS, An Elementary Treatise. By Rolla C. Carpenter, M. S., C. E., M. M. E.; Professor of Experimental Engineering, Cornell University; Member American Society Heating and Ventilating Engineers; Member American Society Mechanical Engineers.

So far as Professor Carpenter may be considered a specialist, it is probably upon the topics treated in this book; and we cannot doubt that the book will, if it be possible, enhance the reputation of the writer upon the same lines. Although modestly styled an elementary treatise, it seems to get in all the elements—and what more could be done? The nature and properties of heat are treated of, and then the principles of ventilation, with the amounts of heat required for various services. All the different apparatus for heating are considered in detail, steam and hot-water naturally being most prominent, and after those coming hot-air. Heating by electricity is considered, and, by the way, it seems to cost about fifteen times as much as direct heating. Heating with refrigerating machines is mentioned, which may appear rather anomalous; but those who have felt the heat of compressing cylinders, and of recently compressed air and gases, will readily understand where the heat would be supplied by such apparatus. The book is readable and interesting throughout, and abounds especially in valuable tables. There are no formidable formulas or higher mathematics to repel the "practical" man. The book comprises 400 pages, with over 200 cuts. We cannot help thinking, after all, that a book of half the size, and at half the price, would have been more widely salable and serviceable. Too many books are too complete and perfect to be companionable. Published by John Wiley & Sons, New York. Price, $3.

ELECTRICITY IN OUR HOMES AND WORKSHOPS; A Practical Treatise on Auxiliary Electrical Apparatus. By Sydney T. Walker. Third Edition, Revised. D. Van Nostrand Co. $2.

We are glad to note the appearance of the third edition of this useful English manual. It should be added that it does not treat of either electric lighting or electric power apparatus. Its scope is best shown by the following table of contents: Glossary of Terms; The Electric Circuit; Magnetism; Galvanic Batteries; Electric Bells; Electric Mining Signals; Telephonic Apparatus; Dry Batteries.

We have received the proceedings of the Third Annual Convention of the National Railroad Master Blacksmiths' Association, held at Cleveland, O., September 3d to 5th, 1895. The journal shows that this organization is doing excellent work, the practical problems that arise in the experience of railroad blacksmiths being taken up and treated from the practical standpoint. We think that not only the members of the association, but the railroads for whom they work, are undoubtedly being greatly benefited by the existence of this association.

One of the newest journals is called the "Technical Journal," and is to be published every other month, by Max Loewenthal (who is also editor), at 248 East Seventy-eighth street, New York City. It will give special attention to matters of interest to students in technical and trade schools, and the initial number seems to give promise of usefulness within its field.

Our Contemporary, the "Tradesman," has issued its seventeenth annual number, which makes a magazine of about 244 pages, filled with valuable matter and information pertaining particularly to Southern industrial interests.

Questions and Answers.

Name and address of writer must accompany every question.

Questions must pertain to our specialties and must be of general interest.

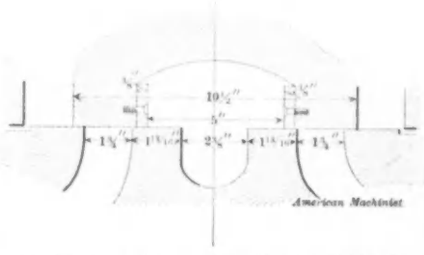
We cannot undertake to answer questions by mail.

(17) P. B. asks: 1. What is meant by the total head of a centrifugal pump? Is it the suction head plus delivery head plus velocity head? A.—We would understand it to mean the delivery head plus the suction head, or the actual vertical lift from one level to the other. If the velocity head were included, then the friction head should also be added. 2. What are the highest possible heads a centrifugal pump may have? A.—Centrifugal pumps are sometimes used, especially in California, for lifts exceeding 100 feet, but the efficiency falls rapidly as the hight increases above 40 feet.

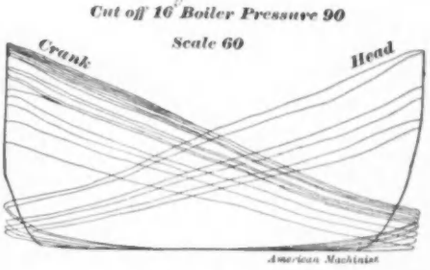
(18) C. A. M., Buffalo, N. Y., writes: Kindly inform me how to make leather shapes which are to be used for gas-well pumps. A.—Since you have not given the shape required, we can give only the general principles which govern the mode of operation. A special quality of leather made for hydraulic press work is the best to use. The leather should be soaked in clean water until it is thoroughly soft and pliable, and then cut to a form suitable for the required shape. The leather should now be slowly compressed between two cast-iron molds into the shape required. After it has been thoroughly compressed, dry slowly, and never heat above 212°, after which remove it from the molds and trim the edges. If this shape is to be used for a pump-plunger packing, then immerse it in blood-warm beef tallow, and, when thoroughly soft, place it in the recess prepared for it. Some experience is required for making the proper allowance for shrinkage, and for making such molds as will not injure the leather.

(19) L. P. M., Philadelphia, Pa., asks: 1. Can you give me a recipe for a glue that will hold a strip of felt to a piece of tin or any other bright metal? It must be waterproof and easily applicable. A.—Try shellac dissolved in wood naptha; apply cold. 2. I have an oil tank 72 x 48 x 33 inches to make. It is to be made of ⅛-inch galvanized iron; the sheets are to be held together at the corners by 1½ x 1½ x 3-16-inch angle iron. Of course, this will have to be braced. Please inform how to find the pressure per square inch on the sides of the tank when it is full of oil, and the numbers and size of braces to be used. A.—To find the pressure per square inch of the oil against the sides of the tank, multiply the distance in feet from the surface of the oil to the point at which the pressure is required by 0.4; the result will be the pressure in pounds per square inch. Thus, at a depth 6 feet below the surface of the oil, the pressure will be 6 x 0.4 = 2.4 pounds per square inch. For bracing the tank, we should use 1½ x 1½-inch angle iron, placed horizontally, and riveted to the sides of the tank at distances, measured from the bottom, of about 15 inches apart; and if the length of the tank is 72 inches, we should use two braces made of the ⅛-inch galvanized iron and about 2 inches wide, reaching from the angle iron near the bottom on one side to that on the opposite side. For the upper angle iron, one brace is sufficient.

(20) R. D. B. writes: I inclose sketch of main valve of our saw-mill engine; also some indicator cards from it. The engine is 28 x 36 inches, with "Meyer" cut-off on back of valve, and runs at 90 revolutions



per minute. The main valve has ¼-inch steam lead and ½-inch exhaust lap. There was formerly only ⅛ inch; but with that amount, the compression was so slight that the engine pounded badly on the center. I added the ⅜-inch exhaust lap,



with the result that the engine runs smoothly with moderate and heavy loads; but you will see that it affects the exhaust release, and cramps the exhaust at the beginning of the return stroke. Would I get a freer exhaust, and the same amount of compression, by giving the valve ⅛ inch more steam lead and cutting ⅛ inch

out of the exhaust lap? This would make the exhaust lap 3/8 inch, and the steam lead 3/8 inch, which latter should not be considered excessive, under the circumstances. As the engine now runs nicely, I want to make no change which may result in uncertainty. A.—We would take off the 3/8-inch inside lap, and put it all on the outside; then, by advancing the eccentric to get the same steam lead as at present, the exhaust closure and the compression would be practically the same as now, while the exhaust opening would be much earlier, and the back pressure would be reduced. The Meyer valve should be set to cut off much earlier, as it is of no use now. The running seems to be done entirely by the governor, and none of the cards seem to rise nearer than 20 pounds to the boiler pressure.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see cover.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash, D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

Engine castings 1/8 to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Brazing Wire and Bicycle Supplies; repairers and manufacturers; see Haines' ad. Ref. index.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill. 913 Tilden street, Saginaw, Mich.

A book useful to engrs & steam users, "Hawkins Instructions for the Boiler Room," $2.50. Catalog free. Theo. Audel & Co., 91 Liberty street, N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Thin emery wheels, for cutting slots, etc., a specialty. The Tanite Co., Stroudsburg, Pa.; 161 Washington street, New York; 139 East Pearl street, Cincinnati, O.

Some Recent Inventions in Metal-Working Tools and Machinery.

A taper attachment for a lathe, patented to Mr. John L. Bogert, of Flushing, N. Y., is shown in Figs. 13, 14 and 15.

The improvement is shown attached to a monitor lathe, the turret of which also presents some new features, but the construction is, of course, equally applicable to other lathes. It embodies a construction which enables the taper attachment to be clamped and started, whatever may be the position of the tool with reference to the axis of the lathe; and, in it, the same movement which clamps the cross-slide to the traveler releases it from the carriage, and *vice versa*. Other improvements in the turret locking mechanism, in the gages for threading, etc., will be noted.

Fig. 13 is a perspective view of a monitor lathe containing the improvements. Fig. 14 is a plan of the carriage and turret base, and Fig. 15 a sectional view of the carriage, turret base and taper attachment, on the axis of the cross-feed screw.

Secured to the carriage 3, are two arms 18, tied together at their outer ends and carrying between them, on suitable ways, a slide 8. To a bridge 12, at the front of this slide, are secured the rear end of the

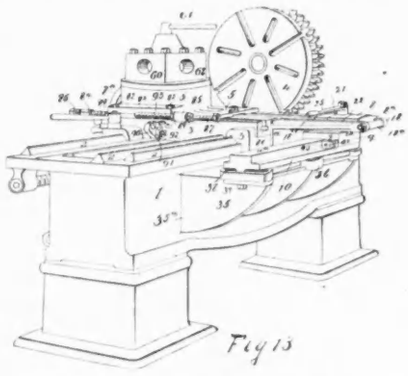
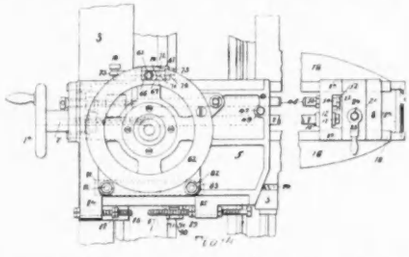


Fig 13

cross-feed screw 7 and, in such a manner as to admit of limited longitudinal motion, a squared rod 46. The amount of play of this rod in the bridge 12 may be regulated by the nut 53.

In the transverse groove in the slide 8 is a shoe 22, the groove in 8 being slightly deeper intermediate of the arms 18, to permit 22 to be clamped upon the ways on 18 by means of the screw 24 and lever



25. As shown in Fig. 15, the reduced end of 24 passes below the slide 8 and into the block 31, which slides in a transverse groove 30 of the traveler 9, this latter being longitudinally grooved on the lower side, to slide on the taper bar 10. A wedge 40, with adjustable and locking screws, gives the necessary adjustment for wear.

The screw 24 is reversely threaded (*e. g.*,

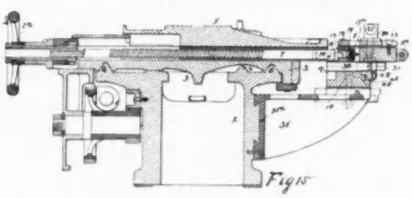


Fig 15

left-handed) on its reduced lower end, so that the motion of lever 25, which clamps 8 to the arms 18, releases the block 31 from the traveler 9, and a reverse motion of 25 raises 22 from the ways on 18 and clamps 31—and, with it, the cross slide 5 and the turret—to the traveler. Thus one movement of a lever supplants all the previous unclamping of the slide with a wrench, the aligning of the traveler and tool-driving rod, and insertion of a pin or driving screw. The hand wheel 7[a] is splined to the cross-feed screw, to permit its longitudinal movement when driven by the traveler.

As seen in Fig. 14, the squared rod 46 may be locked against movement through the slide 5, by a toe on the lower end of the bolt 47. With the slide 8 locked to either the arms 18 or to the traveler, this allows a limited traverse by the screw 7 and acts as a sizing or threading stop, adjustable at 50, as above stated. The screws 86, 87, with their lock nuts 88, 89, answer a similar purpose. These screws abut from either side on a swinging stop 90, pivoted between lugs 91 on the carriage. When thrown upward, this stop limits the motion of the tool in either direction, or, when dropped, the full traverse of the tool is obtained without disturbing the adjustment of 86 and 87.

The turret is hand-operated and is locked directly beneath the tool by the coned end 65 of the pin 66. The lower portion of this pin is rectangular, except for the beveled portion 69, which permits adjustment for wear, by means of the wedge 71 and screw 72. All these parts are held in a recess in the slide 5 by the piece 67. The lever 73, pivoted at 74 and spring returned, passes through a slot in the pin 66, to which it is also pivoted, and is depressed by the button 76. The locking pin seats in hardened, removable sockets in the base of the turret.

In the T-slot 80, on the opposite side of the turret, is the block 81, by means of which and the bolts 82 the turret-base is firmly anchored. This arrangement may be used to lock the slide 5 against cross travel, or may be loosened sufficiently to permit such travel, while still acting as a turret anchor.

About Timber.

An interesting and valuable pamphlet is Bulletin No. 10 of the United States Department of Agriculture, entitled: "Timber: An Elementary Discussion of the Characteristics and Properties of Wood. By Filibert Roth, Special Agent in charge of Timber Physics, under the direction of B. E. Fernow, Chief of the Division of Forestry."

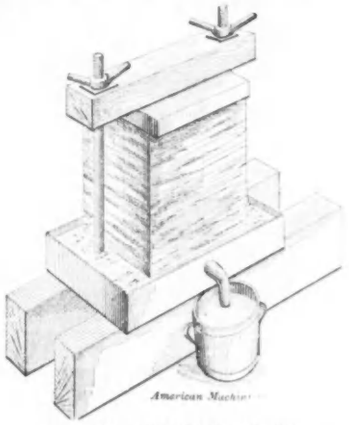
The work treats of woods in general, and of American timbers in particular, giving much information that exists in the experience of practical wood workers, or is buried to us in the technical literature of other languages than our own. Although comprising but 80 pages of text and about 50 illustrations, a surprising amount of information is furnished as to the growth, structure, appearance, characteristics and peculiar properties of the various woods. The weight of wood, the moisture in it under different conditions, its shrinkage, and

then all its mechanical properties are considered, with its durability and conditions of decay and preservation. A list of the more important woods of the United States is given, comprising 115 examples, with a general description of the tree and of its wood. Instructionis how to distinguish the different kinds of wood, and an ingenious key to the subject, are also given We understand that the pamphlet may be had upon application to the Department of Agriculture, Washington.

Electric Traction in England—Obsolete Agricultural Machinery—American Bicycle Tools.

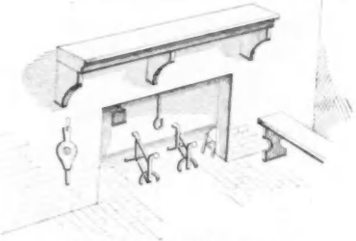
BY W. H. BOOTH.

Just at present the English farmer is the center of a good deal of attention. On the strength of the Tory promise that there should be a duty put on wheat he voted Tory at the late election, and having secured office, his so-called friends have left him in the lurch. As a matter of fact, the position of English agriculture has become very serious. As with all other industries, prices have fallen while rents have still been maintained. It is usual to lay the blame on the farmers of the great west of North America, but there is no sense in this argument, for how is it possible for American farmers to compete on even terms with English farmers who have the advantage in productiveness of soil? There are three causes at work to damage English farming. One is high rent which he pays to a landlord who spends the money in London or Paris. The second is the want of cheap carriage to market, and the third is his own lack of appreciation of the needs of the day—no doubt fostered by his very natural objection to expend capital on land not his own. The first difficulty can only be overcome by the gradual process of self cure. Farms will not be tenanted except at reduced rentals, especially when the whole of the crops are liable to be destroyed by game birds which are protected. The second difficulty, that of cheap transportation, is one which appears likely to be at least considerably reduced. Not only has the farmers' friend, Lord Winchilsea, rather dropped the silly idea of levying a duty on imported food products, but he has actually shown some glimmer of sense in exhorting farmers to pool their interests so as to obtain car load rates in place of paying high rates for small parcels. But, further, there is a strong feeling that we require more railways, and that of a much cheaper and less solid construction than is the standard here, even for little branch lines carrying only two trains a day, though built substantially enough to carry the Great Northern expresses. It appears quite probable that any extension of the English railway system will be in the direction of electrical lines, of which you have so many, and of which there are here so few, almost entirely because there has been so strong a feeling against the use of the overhead wire. Now, however, with an overhead or trolley line at Leeds, and another just opened in Bristol, there is likely to be, as is so very usual here, quite a rush in the promotion of electrical lines, and especially in country districts where existing accommodations are insufficient. Electrical traction here has so far been chiefly confined to overhead lines, as at Liver-



A PRIMITIVE CIDER PRESS.

pool, where electricity is the motive power on the "L" road, or to underground lines, as in London. Surface lines have not yet gone in for electrical traction, except in a few instances, as at Leeds or Bristol, etc.; but very soon they may be expected to be very much more numerous, and seeing that so much has been done in such light lines by American engineers, there ought to be some field for the sale of American traction plant, especially if the amount of business is considerable and the demand grows quickly. The enlivening up of the country villages that would be accomplished by



AN ANCIENT FIRE PLACE.

the construction of such lines would undoubtedly tend to the greater and more extended use of farm implements and the most ardent protectionist could scarcely complain if the demand led to the importation of at least some of these did the result prove beneficial to the agricultural interest.

As a fact, manufactures of all kinds have made such enormous strides, and life in the country is so quiet, that energy has been taken out of the agricultural population. To a city man there can be no more pleasant change than a short time spent in the back country of England. Only a short time ago, I was supervising some work near a small town, which is so ancient that there are to be found cinder heaps and slag left by our enterprising predecessors, the Romans, over 1,500 years ago, and the town itself probably derives its name from one of the first of the "Engles" or Jutes, who came over here from Sleswick or Jutland in the year 449. Nothing could exceed the quiet and restful beauty of the scene. True, there was a railway but it ran, with becoming modesty, mostly in a cutting, affording some instructive geological sections, and only broke out upon the open for the sake of crossing the narrow valley upon an arch viaduct, which served rather to enhance the general effect, and again disappeared below surface level in a cut. On the one side the valley, on the other the woods, tinged almost like the woods I remember on Long Island or near High Bridge, but with more sober colors, as befits an older countryside, and lighted up by the bright, red glow of the autumn sun, formed a striking picture, and served as a setting to the one scene of energy in the middle, to wit, a steam well-boring derrick, with sounding thump doing its best to disprove the theories of the geologists and state facts for their digestion. Running a flying level over the hill, so as to equate the site of the well with one of the so convenient bench marks, "OS", which a paternal government has scattered thickly over the country for the benefit of engineers and surveyors, so that I might check the probable water level in the bore hole from the level of the stream which cut the pervious rock, I came across a farmyard, and was witness of a primitive system of manufacture. Three or four men were grinding up apples in a sort of slicing mill turned by a handle, and the pulp thus produced was placed on a series of fibrous mats, piled one above another to a height of two feet or thereabouts. On the top was a flat, heavy platen, and bearing on this was a cross-head, which was pierced for two bolts, and on top of this were the nuts, which were turned by hand, to flatten the pile and squeeze out the juice. This was the first process in the manufacture of cider, and very primitive it all was. I do not give this case as one where machinery of more elaborate and finished construction would perform the duty better, for I do not know the extent of the operations involved, but it seems to afford some idea of the large opening, even in quiet country places, for tools, implements and machinery. On the other side of the farm and, curiously, higher up the hill, was a mill of small size, its motive power water obtained by damming up the small rivulet and running the accumulated water over a 16-foot overshot water wheel, constructed chiefly of wood, and with an octagonal shaft of wood carried by a gudgeon of iron driven into the end of the shaft,

and running in a primitive bearing with a wooden cover. Further up the hill is the church, on the site, it is said, of the Roman Ironworks, and on the plateau at the top is the village itself, simply a few houses standing round an extensive green. In the inn the fireplace was nearly ten feet wide, with a big arm chair at the end under the chimney, so that in cold weather the occupant of the chair sat really in the fireplace, outside the line of draft. It is all very old fashioned. There is nothing new but the railroad, which is decorously out of sight, and the bicycle, which is here, there and everywhere throughout the whole country; for there is no place, however small, in all the British Islands, to which you cannot ride on a pneumatic, a vehicle that seems also to have become almost as great an influence in America as it has been so long here, and in the manufacture of which so much machinery is required. The cycle makers here are fairly liberal users of American tools, and would be even more so, if the facilities for obtaining them were more extensive; but hitherto there has not been any very great energy displayed in their sale. Every one seems now to use the cycle, and it has evidently come to stay. It only awaits the application of a small gasolene motor to be even more used, and this will come, as in France it already has come, as soon as the amendment of the Locomotives Act has been brought about. These acts, expressly intended to regulate steam traction engines in the interests of horses, which are not afraid of traction engines after one experience, have been made to bear on any sort of mechanically propelled vehicle, and at present stop the progress of all of them. If some people could have their way, they would be made to include the cyclist on a frosty day, when his breath is visible.

London.

Successful Practical Beneficence.

On the evening of January 11th, the graduation exercises and exhibition of work of the Third Class of the Baron de Hirsch Institute occurred at the building of the institute, 225 and 227 East Ninth street, New York City. The building is of four stories and basement, and is devoted entirely to the use of the school, and supported by the magnificent endowment of the Baron de Hirsch. The scope of the school is sharply defined. It takes Russian Hebrew boys, apparently averaging under eighteen, and gives them free instruction and practice in machine work, carpentry, plumbing, or sign-painting. The course for each class is six months, six hours per day, devoted exclusively to practical work with suitable tools. Two classes are graduated per year; and, in addition to the free course of work, each boy is given a very respectable and complete set of tools; and, as they leave the school, they almost invariably find good employment at living wages, instead of hanging around the street corners, peddling shoe-strings, and gravitating towards a life of pauperism or criminality. The exhibition of work done by the boys was highly creditable, the most noticeable feature probably being the variety of the work exhibited, as compared with what is usually seen at such exhibitions. The carpenter boys each make a tool chest for the kit of tools the graduates carry away.

As an object-lesson in practical beneficence, and as a rebuke to the too common practice of pouring money into sieves, the institute deserves the careful study of those who desire to help those who are not so fortunate as themselves.

The second annual meeting of the American Society of Heating and Ventilating Engineers will be held at 12 West Thirty-first street, New York City, January 21st to 23d. Among the papers to be presented that seem likely to interest mechanical engineers especially, are: "Methods of Insulating Underground Systems of Steam Piping," by Prof. R. C. Carpenter; and "Screwed Fittings for High Pressure," by J. H. Barron. Besides these, a number of questions will be presented, all relating to the science of heating and ventilating under various conditions.

Some time ago we quoted, on account of its unconscious humor, an article entitled the "Machinery Doctor," which first appeared in the columns of the "New York Tribune." It will be remembered that in this article the case was mentioned of one of those so-called "machinery doctors," who was called in to locate a mysterious knocking in the cylinder of an engine. When the expert came, he traced this knock from the cylinder along the piston rod, crank shaft, and through the main shaft away off among the looms, where one of the looms was found to be the cause of the trouble. Anyone who knows anything at all about machinery knows that this is ridiculous, yet we find this, and considerable more of similar nonsense, commented upon seriously in a leading editorial of a contemporary which publishes a special mechanical edition, and which ought really to endeavor to comprehend something of the subjects which it professes to treat.

A young man recently arrived in this country from France, for a stay of three years, during which time he will investigate textile machinery and methods of textile manufacturing in this country, and will make a report every three months to the proper department of the French Government, setting forth the result of his observations and study here. He will do this at the expense of the French Government, and the appointment is a reward for high standing at graduation from the Commercial School of Lyons, France, which, instead of being like our American commercial schools, which usually teach nothing more than business forms, teaches a great deal of technical art, and has a weaving department, in which, of course, owing to the location of the school, silk manufacture occupies a prominent place. It would seem as though the example of the French Government in this matter might well be followed by other nations, our own, for example, where it is becoming daily more important that we should possess precise information regarding what is being done abroad, and how it is being done.

Claude Meeker, our American Consul at Bradford, England, is doing a work of special usefulness to American manufacturers by looking after and maintaining a reading and reference room where journals, catalogs, etc., of American manufacturers can be seen, and where information regarding almost any line of manufacture in this country can be obtained.

In addition to this, Mr. Meeker willingly makes special investigations in cases where it seems desirable or advisable, and, in short, makes himself generally useful in advancing the interests of American manufacturers. His example might well be followed by many others of our foreign consuls.

The Fitchburg (Mass.) "Evening Mail" of December 24th, 1895, has an article giving an account of the success of our correspondent, Mr. Peter Lobben, who is the mechanical engineer of the Ivor Johnson Arms & Cycle Works. Mr. Lobben came to this country in 1879, from Norway, and, by persistent application, and by making use of such opportunities as presented themselves for advancement, has risen to a position of responsibility and high standing in the community in which he lives.

Working Steel Like Dough.

Editor American Machinist:

Referring to your article in the issue of the 9th, on the above subject, the following facts will show that the German practice of that method is not new, though it may easily outstrip all else that has been done in that line. A Mr. Cole, of St. Louis, some time in the "fifties," invented a machine and method for making nuts, wherein he cut from the end of a welding hot bar, a lump of metal either square or hexagonal, held it in a box die, and instantly brought forward round punches from either side, driving the metal from the hole into the die; after which one punch receded and the other went through, carrying the fin, less than 1-16 inch thick, out, and finished the hole;

after which the finishing punch was withdrawn and the blank ejected.

This patent has been working in England, at the works of the Patent Nut & Bolt Co., about thirty-five years, and thousands of tons of nuts have been made by it. It was also worked in this country, and may be yet, for aught I know. In conversation with the founder of the Patent Nut & Bolt Co., Mr. Francis Watkins, in 1867, before the advent of steel guns, he expressed himself as being of the opinion that wrought-iron cannon could be forged by forcing a plunger down the center of a mass of welding hot iron, making the hole in the gun the same as in the nut, thus anticipating in his mind even greater work than you describe.

JOHN E. SWEET.

Syracuse, N. Y.

Mr. Alfred E. Beach, one of the founders and proprietors of the "Scientific American," and a well-known inventor, died of pneumonia, January 1st, at the age of seventy years.

Newell North, the reputed inventor of the gimlet-pointed wood screw, recently died insane in the County Infirmary at Akron, O.

COMMERCIAL REVIEW.

NEW YORK, SATURDAY EVENING, JAN. 18.

Machinery and Supplies.

The past week has brought about little change in the aspect of the machine tool trade. Sellers lack exuberant spirits. While there seems to be no occasion to recede far from the position of hope we assumed last week, it is best to acknowledge that the retail trade in this city is now a little quiet and diffident. Somewhat anomalous it appears, that certain manufacturers and sellers report business encouraging, while others of equal prestige do not. But it is probably true that business goes in streaks, and that orders, like misfortunes, never come singly. Trade from week to week in various quarters, also, is found irregular and spasmodic, active and dull weeks alternating, without reflecting any material changes in the undertone of the market. If the past week belongs distinctively to either class, it cannot be characterized as active. There appear to be comparatively few large enterprises going on which would require the investment of new capital, yet it is reassuring to hear such statements as that from one New York house, which says that it could dispose of still more tools than it does were sufficiently early deliveries possible. Another reports that the larger machines, for railroad and other purposes, are in better demand, and also there is a fair export trade to Mexico and other countries. About the most unfavorable feature of the present trade is the prevailing low prices. Some think they tend to go lower still, but considering that people are occasionally forced to sell tools at the cost of manufacture, in order to hold trade, there is little room for movement in a downward direction.

Machinists' supplies, pipe fittings, etc., are weak, and there is probably less business than the season of stocktaking should warrant. Nuts and bolts are very despondent in tone, and even though a comparative dulness until February 1st is natural, the amount of trade is so small as to occasion many gloomy forebodings. The lack of demand seems to be largely accountable for the declines in prices, which have gone down still further since the first of the year. Twist drills, on the contrary, are in good selling, and hold firm prices. They are not especially a seasonable article, yet, owing to its being the first of the year, they are a little quieter now than in December.

Engines, Boilers and Pumps.

The general engine market tells the same old story—throat-cutting prices and not enough orders. In fact, the past week has apparently been more dull than the one preceding. Flakes of business are constantly floating about in the air, but they do not settle. But, as an offset to this, we must take the views of some of the large manufacturers, from whose standpoint the market and its prospects are encouraging. The Abendroth & Root Manufacturing Company tells us that there have been already several good contracts for boilers this year and the usual number of estimates, with considerable export, as well as domestic trade. Pumps are quiet and characterized by a scarcity of orders, and gas engines are not moving in the same lively manner as a few weeks ago.

Motors and Dynamos.

This class of machinery is featureless in the New York market, and some sellers find it a trifle dull, but it is unlikely that there is any material retrogression. People are a little cautious about investing fresh capital. The business of a company manufacturing alternating current dynamos for central stations is reported as having been good for the last two months and still continuing so, the factory being filled with orders. After the first of the year, it is said, this line of electrical goods is naturally a little quiet, though holding a fair amount of trade until the latter part of Febuary or March, a season of practical business suspension taking place from May to August.

Iron and Other Metals.

Some difference of opinion exists as to the present indications of the pig iron market. There is more activity, but at reduced prices of Southern irons. Among the hopeful features are the blowing out of a number of furnaces, Northern and Southern, and a better inquiry, especially from the large smelters. That consumers are still cautious and disinclined to look for an upward movement cannot, however, be denied.

Copper is still selling low and prices are unsettled. Sales and prospects, however, both here and abroad, are fairly encouraging.

Pig tin has been irregular, sluggish, and somewhat lower in price. Shipments from primary points of supply are above the average of the last few years and the visible supply is large enough for six or seven months' consumption.

Pig lead has not, during the past week, been so lively as in the preceding, when business of about 5,000 tons was transacted on a basis of 3 c. N. Y. delivery; but, in consequence of that activity, the price is a little stiffer.

Spelter is reported from the West as slow and irregular in price. Efforts are being made to consolidate producers.

QUOTATIONS.

NEW YORK, Monday, January 20th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 75@$13 50
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 25 @ 11 75
No. 1 foundry, Southern	12 25 @ 12 50
No. 2 foundry, Southern	11 75 @ 12 00
No. 3 foundry, Southern	11 25 @ 11 50
No. 1 soft, Southern	12 25 @ 12 50
No. 2 soft, Southern	11 75 @ 12 00
Foundry forge, Southern	11 25 @ 11 50

Bar Iron—Mill price on dock; common, 1.25 @ 1.35c.; refined, 1.35 @ 1.50c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About 1.55c. in carloads, mill price. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper—Lake Superior ingot, 9⅞ @ 10c.; electrolytic, 9.30 @ 9½c.; casting copper, 9¼c. for ordinary stock.

Pig Tin—In carloads, 13.20c.

Pig Lead—In carloads, 3.05 @ 3.07½c.

Spelter—Western brands, 3.95 @ 4.00c. wholesale, New York delivery.

Antimony—In 5 to 10 cask lots, Cookson's, 7¾ @ 7⅞c.; Hallett's, 6.80 @ 6⅞c.; Japanese, 6¾c.

Lard Oil—Prime city, present make, 52c. in carloads, 53c. in truck loads.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9"X12", 6" X 9" and 4½" X 6". We recommend the 6" X 9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.

W. I. Wilhelm, Hamburg, Pa., sends us a catalog describing and illustrating the Wilhelm bicycle, which seems to possess some points of merit peculiar to itself. It is sent to those interested on application, and is 7 x 9½ inches.

Mr. Thos. G. Oakes, 52 John street, New York, sends us various pamphlets, illustrating and describing steam specialties handled by him, including "Acorn," globe, angle, check and other styles of valves, packing, steam pumps, hydraulic damper regulators, etc.

We have received from the Rand Drill Co., of New York, a catalog printed in the Spanish language, describing and illustrating their rock drills, air compressors, and other machinery used in mining. It is sent to those interested on application, and is 6¾ x 10 inches.

The B. F. Sturtevant Co., of Boston, Mass., have issued a little pamphlet entitled "A Third of a Century of Progress." Though in the nature of a catalog, this pamphlet is something more than that, and will be found interesting and valuable to all who have to do with heating, ventilation, or with the management of shops generally. It is elegantly

printed and illustrated, and is sent to those interested on application. It is 5x7 inches.

John Stark, of Waltham, Mass., sends us an illustrated catalog of bench lathes, watchmakers' lathes, and tools of all kinds especially adapted to watch work. The catalog, besides containing a number of illustrations and descriptions of tools that will be found interesting, has some tables of decimal equivalents of metric measurements and other points of information. It is sent to those interested on application, and is 5½x9 inches.

One of the finest catalogs that has been issued for some time is the general catalog of the Southwark Foundry & Machine Co., of Philadelphia, Pa. This is a regularly bound book, elegantly printed and illustrated with views of the works and its products, which include various forms of the Porter-Allen engine, and also vertical "Southwark" engines, direct-connected to electrical generator, and for pumping, blowing and various other services. We do not know just how liberal the Southwark Foundry Co. can afford to be in the matter of distributing this catalog, but it is well worth having by one who is interested in steam plants. It has 50 pages and is 7x9¼ inches.

MANUFACTURES.

The Brewer Seamless Tube Co., Toledo, O., will build a new plant 100x115 feet, which will be equipped with the latest machinery.

The Standard Boiler Co., of Chicago, have recently removed into new offices at 1120 Marquette Building. They report a good business during the past year, and that new and improved machinery has been put in for manufacturing, reducing the cost.

The Ranfon Boiler Co., which have formerly been doing business in the Porter Mfg. Co.'s shops, at Syracuse, N. Y., have just completed and are moving into their new shops, which are 200x70 feet. Here they have hydraulic riveters, traveling cranes, hydraulic lifts, and other latest improved machinery.

The Berlin Iron Bridge Co., of East Berlin, Conn., have just completed for the Ansonia Brass & Copper Co., of Ansonia, Conn., a new boiler house 65 feet wide and 142 feet long. The side walls are of brick and the roof is entirely of steel, covered with the Berlin Iron Bridge Company's Patent Anti-Condensation Corrugated Steel.

Mr. Thos. G. Oakes, who for some years past has been connected with Jenkins Bros., of New York, has gone into business for himself at 52 John street, this city, and will introduce various forms of valves, packing, and similar things used about steam plants. He will also represent in New York the Mason Regulator Co., of Boston, Mass.

The St. Louis Car Co. and the American Car Co., both of St. Louis, intend to build large works for the construction and repair of street railway cars at Bridesburg, near Philadelphia, Pa. It is also probable that the Peckham Motor Truck & Wheel Co., of Kingston, N. Y., will remove its works, and operate in conjunction with the new car works.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Situation by first-class moulder on green, dry, sand or loam, or as foreman. Box 7, AM. MACH.

Wanted—Position in charge of automatic machinery. Box 21, AMERICAN MACHINIST.

Wanted—Position as superintendent or draftsman of machine works, by experienced man. Address Box 17, AMERICAN MACHINIST.

An experienced steam pump salesman and engineer now open for engagement, east or west. Address Box 24, AMERICAN MACHINIST.

Wanted—Fifty first-class machinists, vise-hands, lathe and planer hands. Apply to the Lodge & Davis Machine Tool Co., Cincinnati, O.

Wanted—Experienced planer hand to run large planer, also to run 7 ft. boring mill. Address The Royal Electric Co., Montreal, Canada.

Superintendent wanted in a machine screw shop doing considerable bicycle work; only first-class men need apply. "Cleveland," AM. MACHINIST.

Representative open for engagement as such, or consulting engineer of a mechanical engineering concern. Address Box 20, AM. MACHINIST.

Wanted—A change of foremanship by a first-class man. At present a foreman in a large engine works. Address J. H. H., care AM. MACHINIST.

Wanted—A good machine tool man as the contractor for the output of entire plant. A good opening for the right man. Box 15, AM. MACH.

Mech'l draftsman, technical education, drawing-room and shop education, will be open for engagement about Feb. 1. Address Box 25, AM. MACH.

A middle-aged man well qualified to design stamping presses and tools, bicycle tools, etc., wants a position. Box 10, AMERICAN MACHINIST.

Draftsman and designer, able to super. construction and erection of work, open for engage't with a mech. eng. concern. Address Box 19, AM. MACH.

Mech. dftsman, prac. and theo. educated, exp. designer of mach. and tools for the economic prod. of work, open for engagement. P. T., AM. MACH.

Foreman pattern maker desires a change; 5 yrs. exp. as f'man large concern build. hvy. mch.; has economic methods; age 39. Box 11, AM. MACHINIST.

Position wanted by tech. man, exp. in manufacture, from drawing room to installation, of steam, hyd. and elec. pow. mach. Add. Box 18, AM. MACH.

Wanted—First-rate millwright; must be up to date and a hustler. Give experience, references and wages expected. Address M. W., care AM. MACH.

Tools and dies, up to-date, 35, American; screw machine tools, milling cutters, etc., experienced in hardening, wants position as head tool-maker. Box 9, AMERICAN MACHINIST.

Wanted—A position by a foreman pattern maker, a believer in adopting ways and means to produce the most satisfactory and economical results. F. W. E., care AMERICAN MACHINIST.

A mechanical engineer, successful designer and first-class draftsman now open for engagement; 20 years' varied experience; specialty, high-grade engines. Address Box 263, Ridgway, Pa.

Wanted—Good, all-around machinist for factory repairs. One familiar with carding and spinning machinery preferred; permanent position and good wages. Address C. & S., care AM. MACHINIST.

Position wanted by good mechanical draftsman and designer, experienced on automatic and general machinery. 12 yrs. practical experience in shop and drawing room. Address, Box 16, AM. MACH.

Wanted—Capable foreman for press room where sheet metal goods are formed and drawn from soft steel; must have experience on D. A. and drawing presses and making tools for special press work. Box 817, Worcester, Mass.

Mechanical eng. and draftsman wants a position; steam pumps, wood and brass working mach., elec. mach., sugar mach., power transmission special mach. Technical graduate and shop experience. Age, 30. Box 22, AMERICAN MACHINIST.

Mechanical engineer, American, age 29, tech. grad., experienced constructor on ice mach'y, Corliss, steam and gas engines, wants position as engineer or constructor; highest-class references as to ability and character. Box 8, AM. MACH.

Change of place wanted by man with wide experience, large and small work, in factories, shops, drawing rooms, foundry. Understands mixing iron, keeping casts and handling labor economically. Member A. S. M. E. Ref. Add. Box 23, AM. MACH.

Wanted—Foreman for assembling department; one who has had large experience on bicycles, both at assembling and machine work; must be competent to handle men and a "hustler." Address with full particulars in regard to experience, wages, &c., George N. Pierce & Co., Buffalo, N. Y.

MISCELLANEOUS WANTS.

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header made by C. H. Bausb & Sons, Holyoke, Mass.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Wanted—Design for a gas engine; will buy or manufacture under royalty. "S. E.," AM. MACH.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Armington & Sims engine for sale, practically new, 125 H. P., $650, wt., 16,000 lbs. S. M. York, Cleve., O.

Wanted—Concern controlling modern machine shop and foundry to build sectional water tube boilers. Address "Boiler," care AM. MACHINIST.

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Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
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Continued on page 28.

BUYERS' FINDING LIST—Continued.

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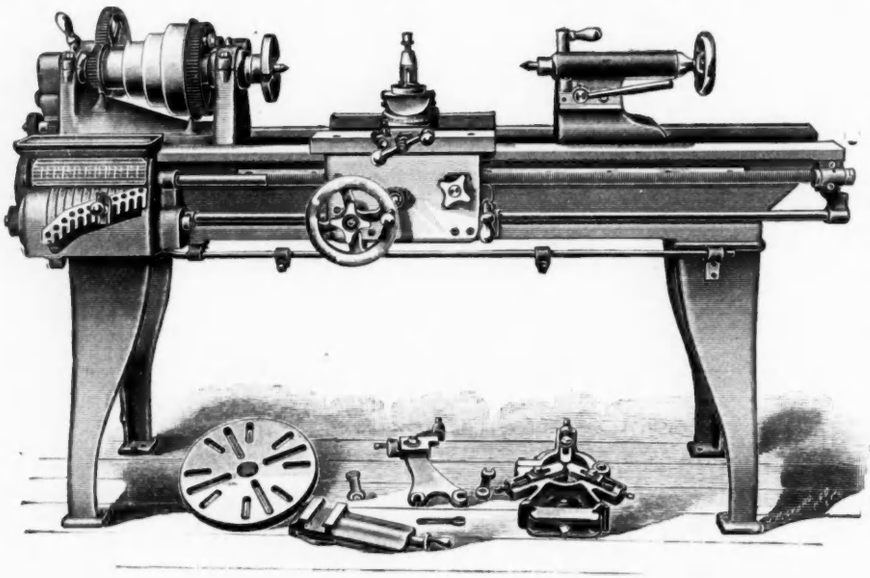

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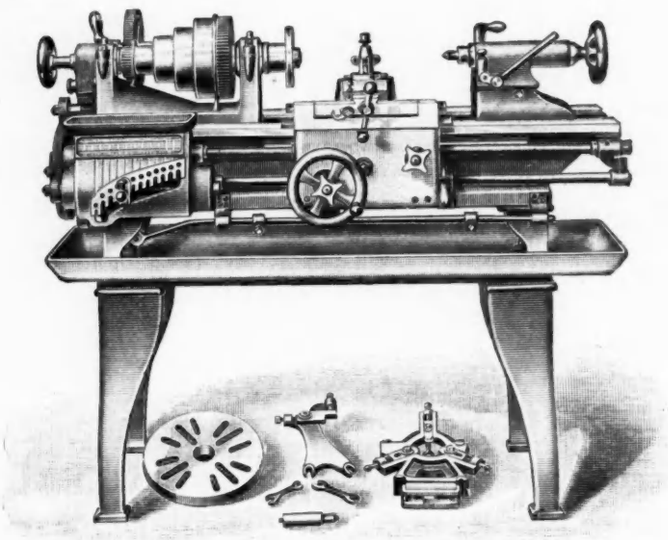

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INDEX TO ADVERTISERS.

	PAGE
Acme Machinery Co	Cover
Albro-Clem Elevator Co	39
Almond, T. R	29 and 33
American Gas Furnace Co	36
Ames Iron Works	40
Ashcroft Mfg. Co., The	Cover
Aurora Tool Works	38
Baird & Co., Henry Carey	31
Baker Bros	38
Barker & Co., William	31
Barnes Co., W. F. & John	37
Besly & Co., Chas. H	35
Bickford, H	33
Bickford Drill and Tool Co	38
Bilgram, Hugo	40
Billings & Spencer Co., The	Cover
Blaisdell & Co., P	39
Bliss Co., E. W	35
Boston Gear Works	36
Bradley Co., The	34
Brainard Milling Machine Co	37
Brown, A. & F	39
Brown & Sharpe Mfg. Co	Cover
Buffalo Forge Co	34
Builders Iron Foundry	35
Bullard Machine Tool Co	36
Burr & Houston Co	31
Carpenter, J. M	Cover
Cincinnati Milling Machine Co	Cover
Cleveland Machine Screw Co	38
Cleveland Twist Drill Co	36
Coffin & Leighton	31
Colliery Engineer Co., The	Cover
Co ke & Co	30
Correspondence School of Technology	36
Conover Mfg. Co	33
Crescent Steel Co	31
Cumberland Iron and Steel Shafting Co	34
Curtis & Curtis	37
Cushman Chuck Co	33
Dallett & Co., Thos. H	40
Davis, W. P	Cover
Davis & Egan Mach. Tool Co	37
Deane Steam Pump Co	Cover
Detrick & Harvey Machine Co	38
Dietz, Schumacher & Co	35
Dixon Crucible Co., Joseph	34
Draper Machine Tool Co	37
Egan Co., The	36
Erlandsen, J	29
Evans Friction Cone Co	35
Faneuil Watch Tool Co	35
Fenton Metallic Mfg. Co	31
Ferracute Mach. Co	39
Fifield Tool Co	Cover
Fitchburg Machine Works	30
Flather & Co	37
Forbes & Co., W. D	40
Frick Co., The	40
Garvin Machine Co	30
Gisholt Machine Co	Cover
Goodyear, S. W	33
Gould & Eberhardt	Cover
Grant, Geo. B	Cover
Gray Co., G. A	Cover
Guild & Garrisen	39
Haines Co., Wm. J	38
Hartford Steam Boiler Insp. and Ins Co	29
Hendey Machine Co	28 and Cover
Hill, Clarke & Co	32
Hine & Robertson Co	34
Hoggson & Pettis Mfg. Co	33
Hoppes Mfg. Co	31
Horton & Son Co., E	33
Hurlbut-Rogers Machine Co	37
Ingersoll Milling Machine Co	36
Ingersoll-Sergeant Drill Co	40
International Correspondence Schools	Cover
Jenkins Bros	Cover
Jessop & Sons Co., Ltd., Wm	31
Johnson Co., The	31
Johns Mfg. Co., H. W	Cover
Jones & Co., B. M	29
Jones & Lamson Machine Co	Cover
Kempsmith Mach. Tool Co	39
Keuffel & Esser Co	40
Keystone Engine and Machine Works	40
King Mfg. Co	31
Landis Bros	38
LeCount, Wm. G	31
Leland & Faulconer Mfg. Co	39
Lodge & Shipley Machine Tool Co	Cover
Long & Allstatter Co	39
Maris Bros	31
Mason Regulator Co	34
McCabe, J. J	31
Miner & Peck Mfg. Co	31
Montgomery & Co	34
Morse Twist Drill & Machine Co	36
National Chuck Co	33
National Machinery Co	38
National Pipe Bending Co	34
New Haven Mfg. Co	34
Nicholson File Co	35
Niles Tool Works Co	Cover
Niles Tool Works Co., N. Y. Branch	30
Norton Emery Wheel Co	33
Open Court Publishing Co	30
Orr & Sembower	40
Otto Gas Engine Works	40
Penberthy Injector Co	38
Place Machine Co., George	30
Pratt & Whitney Co	29
Pratt Chuck Co	33
Prentiss Tool & Supply Co	30
Pryibil, P	36
Quint, A. D	35
Q. and C. Co	39
Rand Drill Co	38
Reed Co., F. E	30
Reinecker, J. E	39
Roth Bros. & Co	40
Roots, P. H. & F. M	Cover
Sackman, F. A	40
Saunders' Sons, D	37
Sawyer Tool Co	31
Sebastian Lathe Co	35
Sebastian-May Co	31
Sellers & Co., Inc., Wm	Cover
Seneca Falls Mfg. Co	34
Shiland & Honeyman	31
Shriver & Co., T	33
Skinner Chuck Co	35
Speidel & Roeper	29
Standard Tool Co	38
Starrett, L. S	Cover
Stirling Co., The	34
Sterling Emery Wheel Mfg. Co	36
Strelinger & Co., Chas. A	35
Sturtevant Co., B. F	34
Taunton Locomotive Mfg. Co	34
Taylor-Rice Engineering Co	31
Timolat, J. G	38
Trump Bros. Machine Co	29
Warner & Swasey	Cover
Waterbury-Farrel Foundry & Machine Co	Cover
W. & S. Hydraulic Machinery Works	35
Watts-Campbell Co	40
Wells Bros. & Co	36
Weston Engine Co	40
Whitcomb Mfg. Co	36
Whiton Machine Co., D. E	33
Wiley & Sons, John	31
Wiley & Russell Mfg. Co	36
Wilkinson & Co., A. J	33
Worcester Machine Screw Co	33
Worthington, Henry R	34
Wyman & Gordon	Cover
Young Mfg. Co., W. C	38

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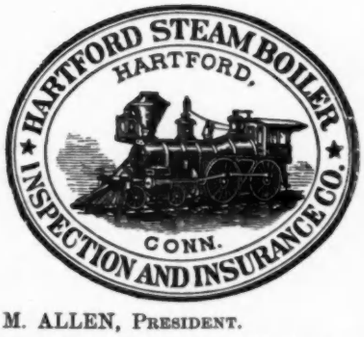

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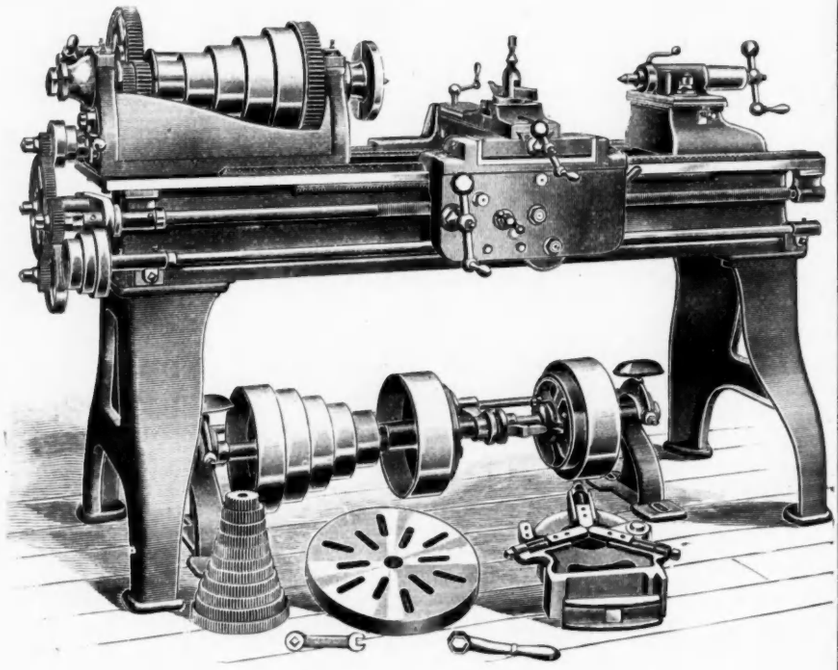

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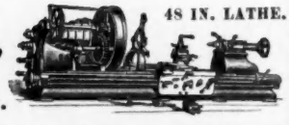

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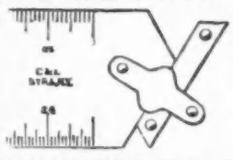

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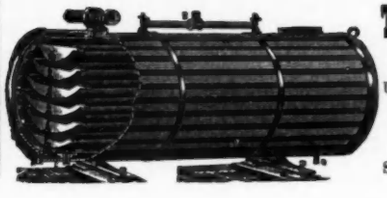

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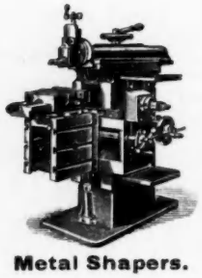

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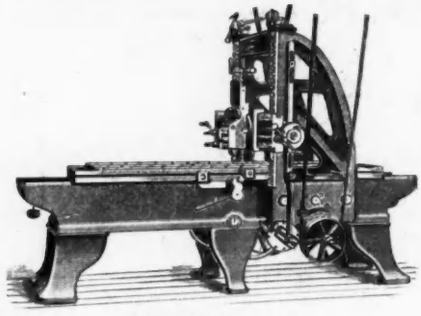

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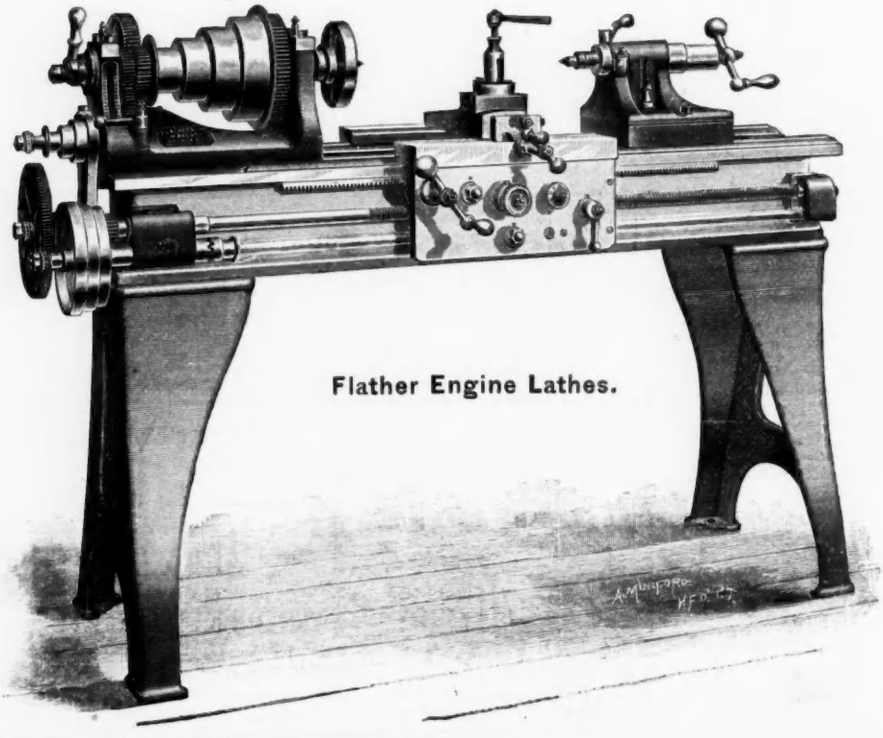

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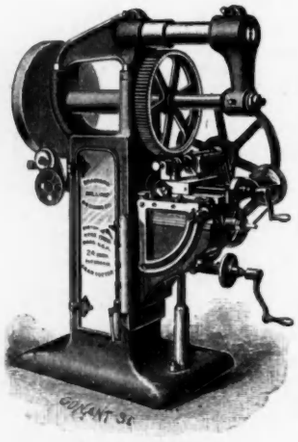

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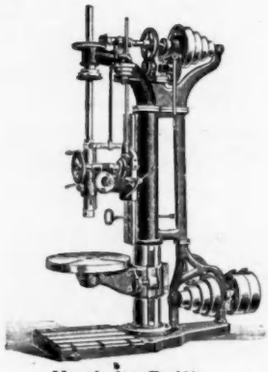

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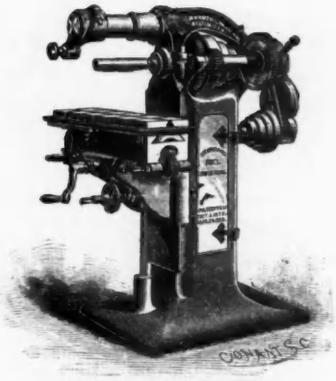

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